NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

+ + + + +

MARS RECONNAISSANCE ORBITER (MRG)

+ + + + +

PREPROPOSAL CONFERENCE

+ + + + +

FRIDAY,

JUNE 15, 2001

+ + + + +

The Preproposal Conference met in the James E. Webb Memorial Auditorium, NASA Headquarters, Third and E Streets, S.W., Washington, D.C., at 9:30 a.m., Orlando Figueroa and Jim Garvin, presiding.

PRESENT: ORLANDO FIGUEROA
JIM GARVIN
STEVE BALLARD
DAVE BOHLIN
JOE BREDEKAMP
JIM GRAF
DAN JOHNSTON
JEFF ROSENDAHL

RICH ZUREK

C O N T E N T S

P R O C E E D I N G S

9:31 a.m.

DR. GARVIN: Welcome to the Mars Reconnaissance Orbiter Preproposal Conference, and I wanted to thank you all for coming. I'm Jim Garvin. I'm the lead scientist for the Mars Exploration Program and the mission program scientist for this mission.

I'd like to, by virtue of welcoming you all, introduce a few of the key players you'll be hearing from today, show you the agenda, and turn it over to our Mars Program director, Orlando Figueroa, who's here in the front row, who will be the first speaker.

I'd like to point out that members of our Mars Reconnaissance Orbiter Project are here sitting in the front row, our Project Scientist, Rich Zurek; the Project Manager, Jim Graf, over there; Bill Mateer and Dan Johnston over there on the far right. We also have the support of our Program Executive, Ramon DePaula, sitting in the third row, and our international coordinator for our

Mars Program, Steve Ballard, is right here, and you'll be hearing from some of those, as well as colleagues from Langley, this morning.

Let me spend one moment going over the agenda and the goals of this meeting for you all. This is a meeting to walk through the structure of the Announcement of Opportunity, the solicitation, explain at high level the evaluation process we're using and, essentially, to provide points of clarification that reflects some of the questions that we've received before the closing time for those questions, which was June 11th. Other questions will be responded to electronically on the web site and in events where they're just points of clarification beyond those that were already submitted here in real time.

I'd like to point out one rule of order. During the morning discussions, we ask, essentially, to hold your questions to the period of questioning in the afternoon, and if you could write them down, we can handle them, if they are directly correlative with the speeches, the comments.

So first let me just grab my pointer. This is the agenda for the day, and I think it's a complete one. Orlando will provide a welcoming from the program and segue to myself.

I'll talk about the overall program strategy, so you see how, scientifically, the Mars Reconnaissance Orbiter fits in. At high level, I'll talk a little bit about the AO that I know you all know is out and available.

Dave Bohlin will talk about the higher level elements of the selection and evaluation process. He's one of our key guys in that.

Joe Bredekamp will talk about the data archiving and the use of the PDS, and then Rich Zurek, our Project Scientist, will explain the full development of the science objectives of the mission, and I will follow Rich with a brief discussion of the science evaluation criteria that we're going to be following.

That will be followed by a discussion of the technical management cost and outreach evaluation elements from a colleague from Langley, and Jeff Rosendahl will talk about the education and public outreach elements of this.

Steve Ballard will be then available to discuss international partnering details with all of you in a question and answer mode, if that's acceptable. We'll have lunch, and then the Project will describe key elements of the mission, as it currently has been designed, for you, and then we'll have the open question and answer period. I will serve as a master of ceremonies for that, and questions that we can answer in real time, of course, we will. The other questions that some of you have submitted have been posted on the web site, and we've handed them out, as well, in the package.

So without further ado, I'd like to introduce Orlando Figueroa. He's our Mars Program director, and he will make some welcoming remarks.

Orlando.

MR. FIGUEROA: Welcome to NASA Headquarters. Thank you for the opportunity to speak to you. I'm Orlando Figueroa, the Mars

Exploration Program director.

Actually, before I begin, my wife, who works for the National Restaurant Association, sent me last night an announcement of this upscale restaurant that opened in New York called Mars 2112, and actually, they went out and spent $15 million in a really all-out restaurant, all Mars themes. Everywhere you go, there's images of most recent of Mars, the whole tables and everything. They figured out already what life in Mars would look like and how they would serve people, so I thought that was kind of interesting. And more importantly, the restaurant was rated A+ by the food critics in New York, so we got to make a point to also make that part of the outreach program. And I found also that they sell Marstinis, as they call them, kind of pricey for New York, but I think we will be able to take some advantage of that.

First of all, and again, welcome to NASA Headquarters and to the Preproposal Conference. You are, you know, part of a process that is incredibly important. That is the competitive work process, whereby we invite the broadest segment of the community to contribute, and we also participate in a process where we can select the very best that eventually makes it to our missions and help us, in this case, get the greatest return in our investment in Mars exploration.

I thought I'd take a moment to walk you through something that many of you might have heard about, and that is the impending reorganization of space science enterprise, and you will notice that on this, the Mars Program, of course, is a very big part of the Space Science Enterprise, the Office of Space Science, under the capable hands of our Associate Administrator, Ed Weiler, and it's called streamlined and proposed. Streamlined, you know, it's one of the biggest things we were attempting to, or Ed was attempting, in this reorganization was to create straighter lines of accountability for the programs and missions under a specific discipline.

In the past, we've talked in terms of themes, science themes. However, the project, the responsibility for those have spread, and it's kind of difficult to keep track of the lines of accountability in that environment.

The major divisions, Sun-Earth Connection, Solar System Exploration, Astronomy and Physics, Sun-Earth Connection under the leadership of George Withbroe, Solar System Exploration under the leadership of Carl Pilcher, Astronomy and Physics Division under the leadership of Anne Kinney. And the Mars Exploration Program office, that I direct, again, are the same level in reporting directly to Ed Weiler.

Jim Garvin, who, by the way, this depiction is not quite correct in showing Jim is housed administratively under the Solar System Exploration but, in essence, you know, hand-in-hand working with me under the Mars Exploration Program and for science issues and matters and also has direct access to the Associate Administrator.

This reflects the recommendations of various review committees that recommended that we establish a single point of contact at Headquarters that would have direct access and direction to JPL to avoid some of the confusions that, in the past, perhaps, led to some of the unpleasant experiences that we had a year and a half ago, and I become then the primary interface and direction to the JPL Mars Exploration Program manager, who just came in the room, Firouz Naderi, and so up to this point, and many of you know I came to the program just a month ago, so I'm drinking from a fire hose but, indeed, incredibly impressed with the caliber of the people and their commitment to the success of the program. So great things are coming for Mars.

Now over the past year and a half, I'd like to take credit for it, but the truth is that Jim Garvin, Firouz Naderi, Scott Hubbard before me spent an enormous amount of time and effort with a broad segment of the community, industry, science, international, in restructuring the program to what it is today.

And this is a depiction of what it looks like. We have the Mars Odyssey that, of course, is on its way to Mars and expected to insert into Mars in orbit on October 24^{th}. Mars exploration rovers to be launched in 2003. The Mars Reconnaissance Orbiter, you know, the mission that you are competing for in 2005, and in ‘07, a rather busy year with a lander and rover, a totally competed scout opportunity.

Ten studies were recently funded, short-term studies, to explore upon concepts that would benefit from a little bit more study that can, perhaps, help us broaden even more the community that will eventually end up competing for the real AO, when it's released. We hope that will occur next year.

G. Marconi, that's the telecom showed on the top, and an orbiter with a significant amount of technology demonstration enabling technology for the ‘O11 sample return mission. In ‘09, another orbiter that is not as well-defined at this point, and in ‘O11, our sample return mission.

Now not shown here is the Mars Express being launched. This is an ESA mission in the 2003 timeframe and, of course, the Japanese mission, Nazomi, that is on its way to the planet as we speak.

So this is, again, consistent with the strategy of seek, in situ, and eventual sample return from the planet. It's very complex, very closely interrelated set of missions that help us put together the whole puzzle of Mars exploration.

Now I will, at this point, stop and allow Jim Garvin to come back and give you some of the details of the scientific strategy behind this picture you see here. Once again, welcome, and I appreciate your time and opportunity to speak to all of you.

DR. GARVIN: Thanks, Orlando. They're not like those New York Mars restaurants that we should all visit in the near future. But all kidding aside, I'd like to spend the next 15 minutes trying to paint the global picture of the science strategy of this program that a large cadre of people developed, some of whom are in this room, and also point out that science is the driver for our program, of course. It takes technology.

That's one of the reasons for this mission. And it also takes good management, and that's, I think, one of the points that Firouz wanted to make.

So I'm going to spend 15 minutes setting up the overarching science, and then we'll talk a little bit about other factors in this program.

I want to remind you that really we're talking about exploring a system not unlike our home planet, and that's why it's so fun and so challenging, and I'll try to make it clear how MRO fits in and leave it to Rich to explain the details a little later. But we have this duo of planets that share many elements, and you'll see in our strategy how we've played upon that factor here.

Now our program, you know, can be described in many catch words, but it really is a science-driven and, indeed, a science-enabled program. We wouldn't be here with this big program without the help of the science community and the industrial and international community to allow us to ask the questions we're asking. And they're pretty tough. They're the questions we haven't fully answered on Earth, and we're really asking about the biological prospects of a whole other world and linking those to the aspects of how that may have worked in the outset here on our own planet and linked to various variables that control the states of that world. And this is the kind of exploration, I think, we've all dreamt of, and that's what our program is all about.

But the way we like to think about the science strategy is in terms of, if you will, the tall poles, and I will, in fact, show you what I like to call the hundred-year plan. We've had hundred-year wars, and there may have been restaurants that have been around a hundred years. We have a hundred-year plan for Mars that some of you have worked on, and there's more good investigations here than I think most of us, scientifically, in our lifetime, would ever imagine. But if you whittled it down and described it in the context of this particular mission opportunity, we've got, basically, three primary science themes, and they all are interrelated to many factors, one of which, at least, is a semi-common variable, is the role of water in its variable states, quantities, and lifetimes. And of course, we're all after biological prospects. That's an interesting variable. It's one of the themes in NASA's strategic plan, are we alone as life forms self-replicating biology. That's great. That's a real challenging thing to do even here on Earth. There's been a revolution in bioscience evaluating that variable, that theme here on Earth, but we can attack that, and I think that's the message here, through the geological record that preserves environments as columns of sediments and even records of igneous processes, as well as through the way ancient records of past environments and even very recent environments are reflected in a climate history that is capturing elements of this cycle.

So if we think about these as two pillars, by exploring these types of issues, which are all germane, by the way, to the Mars Reconnaissance Orbiter mission, we can attack this very challenging variable and start to put the context to the next wave of questions in that arena.

And I put little catch words at the apexes here for the kind of things that we'd like to find. We'd like to see if there were environmental oases, and the Reconnaissance Orbiter may be one vehicle for that.

We'd like to understand more about cycles, and we'd like to look for what I'll call chemical fossils in the system, and that's what we're about. And, of course, ultimately, we also need to prepare the way for some of us to actually go there and do this fun.

So that's the program, and in terms of a science thing, I just want to point out that this program has been developed, and I know you can't read this, by the work of a large sector of our science community through a group called MEPAG and supported also by COMPLEX from the Space Studies Board, and this is just a list of the kinds of investigations that have been identified as being very valuable to do in pursuing Mars, and I should only point out that there are some common features, and we'll come back to that in talking about MRO.

Finally, I'd like to explain the science strategy in the way that I think the scientists in the community, and this is a science mission, it's about science instruments and about science questions and resolving hypotheses. Really this is the way we, in many ways, attack Mars. We attack it by trying to characterize enough of it to establish the boundary conditions, to build the models to predict, predict now and in the past. We attempt to, through those models, understand and cycle through a feedback to learn better.

So the mission that is germane to this meeting, in fact, is all about all three of these elements, and I've listed here, and I won't read them to you, how the various sequences of missions contribute to these three pillars of ways of attacking how Mars works as a planet in space and time.

As you'll see, the mission we're

talking about here fits in in many places, and I'll try to explain that to you in the context of a very simple strategy. It's the one that we use to describe how we attack the science and not the specific investigations. And it's most simply a strategy that is very akin to the way in which we prospect the resources here on Earth, and this is not a natural to geologists, and MRO is really the gateway to this strategy, bearing the fruit that we need to get back to the surface to get to the samples, which we think is the strategy to learn more about Mars.

And the strategy begins with reconnaissance, and this is the Reconnaissance Orbiter, the first next-generation one that we've envisioned for Mars in, at least, my lifetime. And it really is all about asking the kind of questions that we need, the context of the foundation and the where, the where on a very big planet, and that's a challenge to us. We don't have the time or the money to go everywhere. And that's coupled to the surface exploration elements, the first new wave of which we'll begin in the ‘04 landings, the ground truthing, as well as testing hypotheses at new scales as directed by the reconnaissance remote sensing that we do, and, ultimately, that will be coupled through the sampling of the planet, and there will be feedback.

But this, if you will, is the strategy. We've called it seek, in situ, sample. You can call it many other things. At every phase of this strategy, reconnaissance is an element, and what we're talking about here is the big push in this domain for this mission.

Orlando showed you our rogues gallery road map of what we're all about, and I'd like to point out, in this very brief presentation today, there is actually energy in the system before the Odyssey Mission, and I'm going to go back to that for a minute to remind you of where this came up, how this effectively arose. And we are on the way with Odyssey. We are going back to the surface. And today we're talking about setting the stage for this mission to do the work we'd like it to do.

But that mission is really just, if you will, a keystone to what's going to happen out here, and while this may seem a little squishy or a little farther out, we are wedded to this part of the program actually happening, and many will see this mission as the gateway to that.

So let me talk a little bit about why this strategy to help you set the context and, I hope, help guide the proposal writing. I think, and I would ask my colleagues in the room to think as well, that we're undergoing a revolution in thinking about this planet. It hasn't happened overnight, but thanks to a certain intrepid little mission that we call the Mars Global Surveyor, still pounding down the bits from Mars as we speak, we're seeing a new planet.

It's a planet that is, in many ways, unlike the one that we thought we understood at the end of many years of working the rich legacy of Viking data. And it's a planet where we can say today, I think, I could poll the scientists in the room, there's a lot of good places we'd like to get to on the surface and ask tough questions, raise issues about hypotheses.

There is new perspectives on the planet that give it a third-dimensional context. There's the nature of cycles now recorded, not just in the polar layer terrain but elsewhere on the planet. There's a nature of features that suggest run-off of fluids, recent volcanism, climatic cycles, large movement of materials, mass movements, atmospheric cycles in climate. This is a new world, and we're very excited, in the seek mode, to try to capture what the Mars Global Surveyor has given to us and use it as the catalyst for the next wave of missions, including the landing mission in ‘04 and the Mars Reconnaissance Orbiter.

And this is just, if you will, an art gallery of the some of the images that captured some of the findings that the Mars Global Surveyor have now started to leave us with. Findings that start to tell us about the mineralogy in ways that, indeed, are quite surprising, I think. And some of the colleagues who worked hard on getting this mission going, originally called, in part, Mars Observer, have been stunned by what Mars has shown us. We've been stunned by what it's shown us geomorphically, and that's where the MRO fits in. We've been stunned by the arrangement in space, in the third dimension, of the physiography of Mars. We've been stunned by the ephemeral landscapes. We've been stunned by the early record of a magnetic field on a planet, by the variations in crustal thickness, and even by the nature of smooth and rough spots on the planet.

And I'm just reminded that this particular legacy, and I'll show a couple of examples, is why the mission that is the subject of this meeting has come about, and it's why it emerged in this strategy, in part, considered for the ‘03 opportunity now as a keystone for ‘O5.

And just looking at this map, the map of the topography of a part of Mars, if you will, the potentially buried Utopia Basin, is what we're all about. This is a discovery image, I would argue. There is a basin at the scale of the Hellas

Basin right in this view with features, that when they were first recognized by the MGS Science Team, were initially thought to be artifact. They couldn't be real, and if they show up at the scale of the topography shown here -- if you haven't noticed, this is the Elysium province, this is Utopia. These are buried impact features relative to young ones, which have scales of depth of tens of meters at scales of hundreds of kilometers. You wouldn't know you're in one if you were on Earth, unless you were carrying a, I guess, a GPS system and were worrying about being in something.

But this is just one of the aspects of the revolution of Mars, and then, you know, while pictures are not the only way we can study the planet, pictures like this raise, I think, the challenge to us.

When we look at features like this, it's staggering, and I don't know how well you can see the pebbling in the cliff sides here in this part of the Noachian Highlands, but the pebbling is actually caused by megablocks the size of this room clustered in the cliff side. Is this a megaconglomerate? What is this? This is one of the issues that will be raised in this mission we're talking about. What are, indeed, the nature, the formational history, the processes, the physics of these gully-like channels that we see in some of the hillsides, particularly in areas of high slope, particularly in areas of orientation relative to the sun.

These are the enigmas that MGS has left us with, with no clear path of resolution with the MGS asset that we have, and, in many cases, no clear way, from a remote sensing perspective, to have resolution with our Odyssey Mission.

So there's many questions, and so we've built, if you will, thanks to MGS and Viking, the inverted pyramid of Mars, and it's categorized by the findings that we're seeing in many areas, now some of them just being published, actually now, that build this cascade of potential. We're after this, we're after that, we're after the variability of climate, we're after the knowledge necessary to send explorers.

These are the pillars of the goals, ultimately, in our program, and they're challenging ones. MGS has given us, thanks, as well, to Viking and Mariner 9 and Pathfinder, the start, and Odyssey will amplify that start. We'll go to the surface and try to test at least one sphere of hypotheses, but then this next big chunk in this pyramid is what we're talking about here, and the instruments and the science teams, we think, are going to be the thing that guides this part of the program, which will be the first attack on those elements.

So let me just talk a little bit about the context, and then we'll move on. So really what we're about is going from the thousands of places we think are worthy of testing hypotheses at the surface with next-generation surface exploration to a few places, eventually to a few places, where we can understand what we're doing at that new scale. And it's humbling to think that even after the Viking long-lived surface operations, that calibrating what we see at the surface relative to the backdrop of all this remote sensing was very challenging to do. In fact, it was incompletely done. And so one of the first steps is using continuing reconnaissance in the thermal and in capturing the composition, as well as surface ground truthing, to understand that.

I'm going to talk, just very briefly, about these missions in the context of that. The step that is in progress now, which offers great prospects, as well as the Mars Odyssey Mission arriving, as Orlando said, in October, and Odyssey is going to continue our path to understanding the surface of Mars through its mineralogy and its elemental characteristics by, essentially, completing and extending what the original Mars Observer was slated to do.

Of course, many of us who came into the Mars game a long time ago remember Mars Observer was the gate to the future, we're going to do it all at once, be set, and we've unbundled Mars Observer due to some setbacks in our program. The Odyssey is the very exciting next element in that unbundling, and

Odyssey will look at the planet in the middle infrared to look for mineral clues, which is vital to the program, as well as compositional clues based on hydrogen abundance and on other bulk elemental analyses at, if you will, continental scale to resolve some of the key issues with the global economy.

So Odyssey is a reconnaissance mission and a global inventory mission. It will complete some of the foundation data sets and, in doing so, help, together with MGS, to guide the path for our twin Mars exploration rovers that will visit, for the first time, new types of sites on Mars with new tools. In this case, tools very well suited for being a geologist on Mars, knowing somewhat what the materials are like, knowing the questions.

These particular pairs of rovers launching in middle ‘03 and arriving in Mars in January or February, '04 will explore at new length scales and new spatial domains and new spectral scales what we see at the surface, even inside of materials, at somewhat microscopic scales, as well, in ways that will be coupled to the remote sensing legacy of the Global Surveyor and the Odyssey. And this is a vital part of our program.

The aim is to use this new approach in ways, in fact, that have proven to be advantageous, even in exploring places on Earth autonomously. And this is just a little view of how imaging and hyperspectral imaging together, not on Mars, of course, would be a great place to land next to these canyons, of course, on Mars, and we certainly would like to try and have that challenge.

But this being Earth, this is one of the ways one can imagine the strategy of these rovers. With the capability of the scale of hundreds to nearly a thousand meters, one could remote sense, horizontally, the structure of cliffsides, if one had them, locally conduct high-resolution hyperspectral analyses of the mineralogy of materials all the way down to scales of centimeters, and interrogate, in fact, spectroscopically with continuous mineral infrared spectra, the mineralogical makeup, and then go explore with near, if you will, contact sensing, as some of our colleagues said, what's really going on inside and at the surface of rocks and soils.

So the MRO missions will explore Mars in this way for the first time, something we've all dreamt of, I might say, as Viking was there and its static framework of being able to reach out and do this. This is the natural culmination of what Viking and Pathfinder Sojourner did, and it is a very important step.

But as a result of this, what will we have? In our strategy, we'll have two sites with scales of hundreds of meters, we hope. We're reasonably well calibrated. We'll be able to bootstrap into the understanding of Mars, at least sufficiently, in a crustal column sense, globally and extrapolate places that seem to behave that way. That's what we'll have. We will have honed down the trade space of what we understand to some units that we may understand. That's fine, and that's a great thing.

But the next cycle in our strategy is to continue reconnaissance because with that in mind, we believe, and that's where this mission and the topic of today's conference comes in, we will amplify the effect of what we learned at the surface to set the stage for the new landings at the latter part of the decade and early next decade, when we implement sample return.

So what we want to do is take thousands of good places down to hundreds, calibrating them, down to a handful. And these will be the sites, thanks to the Reconnaissance Orbiter and its whole range of science goals that Rich will describe. This is what we wanted to do in a macroscopic scale, find the places where we can ask the tough questions with a new generation of precision landed and hazard-avoiding landing assets on the surface. That will be the first wave toward Mars sample return and, ultimately, set the stage for even interrogating materials at scales where they may actually have left records, at least chemically.

And I will say very little about the mission because I'm going to leave it to Rich, but the goals that were originally developed for a Mars Science Orbiter concept that we studied for the ‘03 mission were to look at Mars in new dimensions to complete the work that was sadly challenged with the loss of the Mars Climate Orbiter and to look for evidence, indeed, of this magic molecule, water, in new ways, mineralogically, at least and, now the added dimension, even in terms of the context of the upper crustal surface layer.

I'm always reminded, when I think about this mission, of the kind of thing that we take so much for granted here on Earth, and this is actually a photograph that I took, poorly digitized, taken at a very advantageous solar elimination angle of a place that some of us like to go to if we're near Martians, and this is the 1.2 kilometer Barringer Crater in Northern Arizona, a very recent crater, and just looking at this picture as geologists, panchromatic image, digitized now to about 80 centimeters a pixel, best I can do from the photo I took, taken at low sun, shows you, in fact, things we recognize on Mars. We can see that there's a fill that causes this boundary. We can see these gullies. We can see the overturned flap reflecting these beds, of course, the action of humans messing up the pretty land form. But, again, this picture and, of course, the evidence of life here showing up as vegetation, not the things of Martians. There's even a place, a coral, down here where, I guess, cattle were herded at times, a watering hole.

But I'm reminded that at this scale now, every picture becomes, if you will, a geological field trip because we can recognize things that we understand process-wise and can start to interrogate. And this is one of the reasons, one of the many reasons why the Mars Reconnaissance Orbiter is so vital to our program.

Now the Mars Reconnaissance Orbiter will set the stage for getting back to the surface, and our program strategy, which we've called seek, in situ, sample, goes back to reconnaissance at the surface in the ‘07 opportunity, landing in ‘08, with a mission that has many jobs, not only scientific. And the science, in fact, is being framed now by a science definition team that's actively meeting. But amongst the goals are to go to a place identified by the legacy of reconnaissance from MRO in the previous missions and explore the surface where we think the action is at new scales in places that aren't just equatorial landing sites enabled by our current degree of knowledge.

And I'd like to remind you that this mission has a very big job. It has to serve as a Pathfinder for some of the technologies needed for Mars sample return, one of the keystones of our program. We have to be able to land not at scales of tens of kilometers relative to things we want to visit but scales of a few kilometers, and that's very vital.

We want to be able to then conduct new scales of science, perhaps accessing the subsurface or exploring it in new ways, monitoring scale atmospheric measurements that will amplify the atmospheric measurements of MRO, and new types of analyses of the materials we see there, new types of interrogations, which, again, are being crafted.

So this mission has many roles, and in demonstrating some of the technologies that are needed on this particular mission, we'll be getting ready for Mars sample return, so those of you in the room might look forward in a couple of years to the Announcement of Opportunity for the instrumentation for this mission.

And that leads us then to a very difficult to read, but, basically, the program thrust of the core part of this program scientifically for the period up until the landings in '08 and, basically, taking us from the old Viking Mars, as I explained, through this new Mars that MGS has energized for us with new types of places that become exciting, of course, the sites we've seen we haven't the calibration evaluation that we would like, to more sites that are amplified by the work of the Odyssey Mission, ultimately to places we visit, selected through the vehicle of these missions and the legacy of Viking, just some placeholders here just as the kinds of things that are under consideration.

And, ultimately, then using all that

information, together with what the MRO Mission has to do for us to find the places where we will precision land to explore the surface scientifically. And basically, that strategy of winnowing down and progressively exploring Mars leads to the program I showed before, leads to these legacies of missions that allow us to explore the questions I put at the apexes of this particular triangle view of using water as one of the connecting elements.

So we want to be able to image things that we think are where some of the action may be recorded. And this sequence allows us to follow up on MGS through MRO. We want to be able to look for, at least, chemical biomarkers, perhaps, through minerals. We want to be able to look for chemical indicators of environments through minerals and subsurface contacts and atmospheric processes.

This is the strategy of the program that sets the stage for Mars sample return, and on top of that strategy is our Scout Program. It's a mini-discovery program for Mars. The first opportunity will be in the '07 opportunity, and we have, as Orlando said, just very excitedly selected 10 concepts purely for study to look at whether these would be good things to do with high science merit and implementation possibilities.

But the idea is to look at Mars in new ways, to extend the range of that core program focus, looking at parts of Mars that, perhaps, cannot be attacked through that program, to look at new vantage points to get ready for things we may want to do for sample return. These are individually competed PI missions, and I suspect, actually, some of you back in the room, when the AO for that and the preproposal comes out in early next year, as we begin that program. But it's a very exciting program to all of us.

And basically, these missions together then and these concepts build a science path to what we would call a program, a campaign of sample returns of different types for different types of materials. The first of which, at least in our imagination now guided by our science groups, will be ideally to places where the sediments and the minerals may record the environments that we want to explore, in particular for aspects of what might be biological prospects.

So this is the staircase of things we need to do. This particular mission we're talking about builds on several of these stair steps toward what we want and, we think, is one of the ways in which, when we execute this very complicated sample return mission, the sample return mission will be more than those that we had imagined before. It will actually be a sample return mission where we'll have a great degree of information about what it is we want to sample, where we sample, and we'll continue the exploration in situ of the mission.

So there's a lot of things we expect, and this is a chart that I made to describe to Congress, a lot of things we hope we'll learn. I can't say we absolutely will learn them, but we'd like to learn these kind of things about Mars through this program. And I urge you to think about this in context of this mission. Where water is, was recorded and what amount, of course, has been always one of our aims, how environments worked. We have some vestiges of how that is happening now through MGS and Viking. Whether there are any directly biologically-relatable materials that we can sense, remote sensing-wise, and ultimately test at the surface.

We want to understand the workings of modern climate to get at how Mars has been affected by these climate engines that we know work on Earth, roles of obliquity. We want to find where the energy in the system is that can explain these enigmas, things that allow us to imagine wholesale exhumation of multi-kilometer stacks of rocks, and where did the stuff go, where did it come from? We have big, big challenges. When you go to the Grand Canyon, you can sort of figure that out. We haven't quite gotten to that point on Mars. And we really need to ask what do we need to measure, as we think about this Holy Grail of life detection, which is so challenging.

So I have to put a view in for what the

future will hold because I think where we are going in our program is this key pillar of the science strategy. It will get to a point where it will merge into strategies we have in place for human exploration, safety and science driving them, and technology, of course, where we will be conducting exploration on Mars, and I think this mission, the MRO Mission, that you are all here to talk about, fits into that strategy by helping to identify places to go, places that might be safe enough to go, so that the human explorers, in some cases, will make some of the eureka discoveries.

And I'm reminded, in finishing my talk, that we can imagine this happening, and maybe it won't be no fishing, maybe it will be no microbing or something. But in any event, this is the Mars that we may find, but we obviously need missions like MRO to get us there.

I'll conclude with a picture that I think is worth more words than I can give you. This is a synthetic fractalized view of an approach that might be taken by one of the ‘03 missions, as we come into a place called Melas Chasma. The problem is, you know, this surface looks real, it's great, it's real exciting, and we don't know what it is. We don't know what the scale of structure in it is. We don't know how safe it is to come even near it relative to orographic winds and the workings of the planet, but boy, we would sure like to be able to go to these kind of places. And this mission that we're here to talk about with you all today is all about that.

So that is the program that we have, and I'd like to next turn to explain the AO to you a little bit in the context of our program, specifically for this mission.

So what are we here about today? We're all about talking about the Announcement of Opportunity. It was posted, I think you all know, last week, and many of you have asked questions about it. So let me spend the next couple minutes going through it, then we'll turn to a description of the mission in more detail by Rich and the team.

Okay. Well, firstly, as I think you saw

by the AO, we don't have a lot of time. This is a very exciting mission. We are launching in August '05 and not a lot of time for developing the instruments. We are looking for, in this solicitation in particular, relatively mature investigations that will not be challenged by that short development time, and we are asking for a lot, I recognize. And that's one of the things that I want to make very clear. This is something that was recommended to us by our scientific advisor groups and by the Science Definition Team, and these are the key dates then.

As you know, the AO came out last week, last Tuesday. Proposals are due in 75 days, in the end of August, the dog days as they're called here in Washington. We are anticipating selection by our Associate Administrator, that's Ed Weiler, Dr. Ed, by early to mid November. That's critical for us to launch these phases of the mission. We imagine a launch in August, of course, arriving in March, and conducting one Mars year primary science mission, and then serving in a relay phase for the landed assets that will reach Mars in '08, supporting our 2007 landing mission. These are the project milestones, and that's, of course, time-limiting.

This particular AO is soliciting several types of investigations, and I'll go over those briefly. You can all, of course, read the chart. We're talking about two specifically ear-marked types of instruments for the mission. They are to be led by individual principal investigators and their teams, of course, and that's stated in the AO. And we're also looking for facility science team members for four different classes of scientific experiments. And they're, of course, in a different class than the specific hardware PI investigations.

These are the different classes of investigations you know. I want to point out a couple of things that Rich will amplify on when he talks about the science particular of the mission. We have reselected experiments by virtue of the recommendation of, actually, two science definition teams lost with the sad demise of the Mars Climate

Orbiter that are vital to understanding the atmosphere of the planet. They eventually will be vital for us to undertake missions involving air capture, understanding climate, and that is, of course, the Pressure Modular Infrared Radiometer, Mark II, and a wide angle color UV camera that sets these things in context.

I want to add in this AO, we are not soliciting any more science investigations or members for these. In fact, we are in the process as we speak of reselecting the investigations as they were. This is the same process that was used when we went from the Mars Observer to the MGS mode in the program.

Now we will be looking for new facility investigations with respect to the recommendations of the Science Definition Team in the area of a context imager. This particular mission is all about high resolution spectral and spatial domain measurements of the planet Mars and the feelings of the Science Definition Team, where that context is required for that. A new instrument for this will be selected by NASA, but no new science teams will be solicited in this investigation because this instrument is planned to be run by the originally selected MARCI Science Team.

Let me turn to the next page. Now we have a provisional selection of a contributed instrument by our partners from the Italian Space Agency. This is, basically, a shallow subsurface sounding microwave instrument that will look in the upper hundreds of meters to kilometer of the Martian surface at high spatial resolution and high vertical resolution. This particular solicitation is directly soliciting the U.S. and other international components of the Facility Science Team, including the deputy team leader. This is very important. This is a very challenging experiment. It's designed to, in fact, extend what will be learned from the Mars Express Mission with the MARSIS but to new domains, the shallow subsurface rather than the deep subsurface. And one of the key points of AO, and I can only stress it again, is we are soliciting not scientists to purely interpret data that's at level two, three quality, but we're soliciting science team members for this particular facility instrument that are expected to be experienced radar scientists experienced with understanding decisions that will need to be made as this instrument is developed for flight. That's very important. That will be part of evaluation criteria for selecting those.

Now, of course, the key part of this AO are the new principal investigator, instrument investigations. Rich will talk about exactly what they're going for. In a high level, they are searching local spots on Mars in a global context with global access to places where mineralogy and morphology, if you will, geomorphology at very small spatial scales, reflect evidence of processes that we're searching for involving water, hydrothermal activities, and things like that.

They're after, also, a better understanding of this incredible layer cake nature of the planet Mars and understanding stratigraphy and eliminating or favoring processes that will reflect what's going on is very important.

We have a recommendation for the kinds of instruments. It's stated in the AO and described in the PIP and in the Science Definition Team, and so I urge you to read this sentence, any type of instrument that can address the science objective, stated in the AO, is permissible to be proposed.

The work of our Science Definition Team in looking at how to best attack those challenges and tracing them to the guiding science of our program recommended a particular pathway to achieving the objectives, but there is the possibility of looking at alternate approaches to the creativity of the proposing principal investigators and teams, just to point that out.

There are cost guidelines. They're in the AO. You can see them here. They are reflective of the way in which we're implementing this project.

There are also another class of investigations that are very important in the AO that are vital to keep our understanding of Mars continually. They fall into the classes you can see here. I'll start with, of course, the first one. We have, essentially, facility capabilities on the spacecraft, and you'll hear about that from the Project. One deals with what we need to understand about the atmosphere of doing aerobraking, and so we are looking for our facility team investigators to use the information to understand the atmosphere to pave the way for better aerobraking and aerocapture in the future.

They will be tracking the spacecraft, and you'll hear about the orbit geometry that's imagined for this, and we're looking for Facility Science Team members to use that information to produce new and higher resolution gravity field information and interpret it, in light of crustal structure.

We're also looking for continuous studies of the atmosphere using the telecommunication system on the spacecraft as a science asset, as we've done with Mars Global Surveyor and are going to be doing with Odyssey. These are the classes of other facility investigators we're looking for, other than for our partner instrument, the shallow subsound with radar.

I want to point out that the final disbursement of these types of investigations is dependent upon the actual implementation of the spacecraft, and we'll do our best, of course, to facilitate doing these, as well as the overall funding envelope.

So that's a high level description of the solicitation, what we're looking for, PI instruments in a couple of areas to deal with the top science issues, Facility Science Team members, and I pointed out that we've reselected investigations to capture other things.

So what I've tried to do then is give you the program, I'm over by a couple of minutes, and talk a little bit about the AO. I'd like to turn it now to Dave Bohlin to talk about how we actually are going to evaluate and select this, and Dr. Weiler will be the selecting official.

Dr. Dave.

DR. BOHLIN: Good morning. My name is Dave Bohlin. You may see my name come up any number of times regarding solicitations process.

I've often said I have probably one of the longest job titles at NASA, I think, Senior Science Program Executive for Review and Evaluation. I have the ubiquitous honor of having a business card, a fold-out business card to get all that on.

(Laughter.)

DR. BOHLIN: What I want to talk about is process, but it's process, a very important process, and that is how do we do the proposal review. This has actually turned out to be pretty standard for most of our big AO's now. There is some variation a little bit occasionally, but it almost always runs as follows: We release the AO, preproposal conference, you are here. We then have a kick-off meeting of our evaluation team, and this is just to get people oriented, and that is, for the most part, for the TMCO review, not our science reviewers. That comes a little bit later. Proposals are received. In this case, you have a relatively short time to get the proposals in. Folks, can't help that. That's because of the launch schedule.

We do a very careful compliance check of the proposals. The AO has any number of stipulations in there about how the proposals are, and we're not talking about just page blanks here, but any number of other factors that have to do with the proposals. The main point is we don't want to spend our time or our reviewers' time reviewing a proposal that somehow is not fully compliant with the strictures of the AO. So this process is, in fact, quite detailed, takes several days. They have quite an extensive checklist that they go through to make sure that everything is in order, the signatures are there, or if you've got non-U.S. collaborators that we have letters of certification, etcetera, etcetera, etcetera.

We then get into the evaluation process itself. There is the science evaluation, of course, which everyone thinks of because many of you and certainly scientists have participated in science panel reviews of one type or another. But we also do the technical management and cost evaluation.

Now a team of people, for the most part

consultants, about half, roughly, are retired NASA personnel. The other half are active personnel from private industry, not industry in terms of aerospace but consultant-type people. And we even have a person, not always, but from the Air Force office that deals in satellites. It's a very good group of people. We pay them extensively for their services because many of them are acting as consultants, and they really work hard because what we have learned in the proposals is that we've got to make darn sure not only is the science good, but are these things going to work in terms of technical capability and is the cost likely to be a realizable thing, and is the management structure there to pull this thing off in a short amount of time?

So there is a great deal of emphasis put on this TMC evaluation that results in an evaluation at two levels, risk we call it, low, medium, or high. And that risk can come about because of a management factor. It can be very heavily based on a cost factor or on the technical side. It doesn't make any difference. The issue is what is the level of risk of this particular investigation, and that can become an extremely important factor as we get into the final selection process.

There is a new technical evaluation where we look at new technology and, finally, the education and public outreach evaluation issue is handled by a separate small peer panel, and I think most of you are aware now that NASA, right from the administrator on down, is extremely committed to education public outreach. Ed Weiler talks about this all the time, and he tells us time and time again in staff meetings, he almost never goes up to the Hill, that education and public outreach is not raised by staffers or the senators and congressman to whom he's talking in the various meetings. So I absolutely assure you that this is not to be overlooked. I also absolutely assure you that this can and has been and will be a factor in the selection, and we do not make this a factor in the categorization or the recommendation, but at the final selection process. E/PO has been and will probably almost certainly continue to be a tie breaker between otherwise equally competing proposals. So folks, don't overlook it.

All this comes together in two primary meetings. There's, first of all, a plenary for the technical management cost team, which pulls together all the factors they've been looking at, and this then is given to the science plenary, although the science group does not change what the TMC rating is, but at least they are aware of it.

The science group then pulls together all the science ratings, and that results then in a series of sheets of paper. Typically, for an AO like this, you're looking at easily a dozen pages of material and maybe more of all the evaluations that have been done, which are put into a binder for all the proposals then that are received.

The next step in this is a step called categorization, which I'm going to come back to in just a minute and give you a little bit more in depth. That's a little bit of a mysterious process because it's an internal process, but it is required by federal acquisition regulations, which we're constrained to follow.

But let's just point out that the categorization process leads to a subset of the most highly ranked proposals, which then we do what we call an accommodation assessment, which is just what the words imply.

We look at the top rated proposals and ask, especially now we're talking about the hardware ones, of course, do they fit? Will they fit the spacecraft that we want to build, will they in terms of power cost, telemetry rates, and so on, along with the program requirements and budget considerations which are what are laid out in the AO, so there's nothing really new here that's being introduced, come together, and the program scientist now gets to generate a recommendation for selection. I would say this is the payoff for the program scientist for all the hard work, which, by the way, the program scientist is the ring leader of all this. He or she is the ringmaster, I should say, trying to pull all this together.

They finally come down to this relatively small number of proposals, where, especially, now we're talking about the hardware proposals, how are those going to fit on a single payload, so that you don't exceed your resource requirements and capabilities?

This recommendation then is brought forward to another internal activity called the Space Science Steering Committee, which I will address also in a few moments in just a bit more detail, but let's just say that this acts as the eyes and ears for the Associate Administrator to look over everything that's been done in advance to make sure that nothing has been left out, that the process has been followed, and by process, I mean the legally specified process has been followed, that all the paperwork is in order, and records are there to support and defend a final selection.

We then make a recommendation to the Associate Administrator, who is a selecting official, and the Associate Administrator is free to call upon any additional outside consultants or advisors that he or she wishes to do, but the AA, and the AA alone, is the person that signs the so-called selection statement, which is the final document which makes the selection final and legal.

We then announce the selections here. Our target is mid November, and immediately, of course, we want to initiate the contracts and, finally, of course, debrief people as to how we did.

So what I want to do now is back up and talk about two things that, as I said, you don't normally see from the outside looking in because they are internal to the acquisition process that we're legally required to follow, and that's categorization and the Steering Committee.

First of all, before I leave this slide, is there any questions, in particular, that anybody has?

(No response.)

DR. BOHLIN: This has been pretty standard for quite a while. The categorization process, and I just wrote an article on this last year, and it was published in a book, actually, so I had a chance to do a little historical, I call it hysterical, research on where did categorization come from. It turns out it's almost as old as NASA. NASA was founded in about '57. By 1960, this process was already in place and becoming formalized.

The point was that, first of all, you've got to realize that there is a very special issue here concerning the acquisition process. There is a thing called Federal Acquisition Regulations or FAR. Now all the government has to follow FAR. You can go to the web, you can look it up, and it goes on for pages and pages. If you published all the Federal Acquisition Regulations, you get about this much on your bookcase. It's rather daunting. But it turns out there are three agencies in the whole federal government that are allowed to rewrite FAR for their special issues, and NASA is one of them. The reason is very early in NASA, they realized that we're going to do something very different.

Normally, Federal Acquisition Regulations are used to acquire or to obtain for the federal government to buy fleets, like battleships or boxes of pencils, okay? And you can specify exactly what you want. You want a writing instrument that shall be so long, it shall be so big around, it should take a certain amount of force to make a mark on a piece of paper. But in the case of NASA, they realize we want to acquire an investigation, which by definition means an orderly pursuit of knowledge and many times requiring the provision and flight of hardware, which produces data that is then analyzed and published.

A lot of people will say in AO, we're just asking for a piece of hardware. No, we're asking for an investigation, and if you read the AO carefully, you'll see time and time again, it uses the word “investigation.” It doesn't say we want a particular piece of hardware. Now in a few cases, it might be fairly specific about the kind of hardware we want, but it will always say and almost always say, and Jim's slide was very specific on this, we have a recommendation for two specific pieces of hardware for this mission, but the AO says you can provide anything else that achieves the science objectives that we're after.

So this is the neat feature of the AO process for NASA. It allows the creativity of the marketplace, as I like to say sometimes, to come up, and this is where the generation of new ideas and the thing that has allowed, time and time again, NASA's programs to make the advances that it has because it allows creativity to come into the picture.

So that is called an NASA FAR Supplement, and the particular one we're talking about is 1872, and in there is Paragraph 403, and in there you'll find the definitions of categories.

The beauty of the categorization process is that, many times, when you're reviewing these proposals, you have all these various factors that you have evaluated, cost, the value of the science investigation, the integrity of the team, the likelihood the experiment will work, the data evaluation plan. All these things have a different evaluation factor. The categorization allows you to pull all that together into one of four bundles. Category one is, basically, the top of the heap. We all can see scientifically and technically sound investigation, and I highlighted that to emphasize that the word is investigation pertinent to the goals of the program objectives offered by a competent team from an institution capable of supplying necessary support to ensure that any essential flight hardware or other support can be delivered on time, that the data can be properly reduced and analyzed, interpreted, and published in a reasonable amount of time, and that, again, gets back to the fact that this is an investigation. It's not just a piece of hardware to churn out data.

Investigations in category one are recommended for acceptance and, normally, would be displaced only by other category one investigations, so that's your top of the heap.

By the way, let me point out that the categorization process is carried out by a subpanel, and it must be civil servants by law because this is an inherently governmental function, and also we, the government, have to take responsibility for this. You can't do that if you have outside advisors, I mean non- government employees.

So we draw a small group of people from inside the Office of Space Science, although occasionally we'll have people from other federal agencies, for example the Smithsonian, the Air Force, NOAA, anybody that we can find that we think is scientifically and technically competent to understand the peer reviews, and they look at only the peer reviews. They no longer look at the proposals. They have the peer reviews in front of them, and based on the peer reviews, they vote on each proposal. It's discussed in open forum.

I will also say that usually and almost always the people in the categorization panel are people who are not in the direct program area, so, in this case, it's a planetary program, so the internal program scientists that we'll look for will be people from our astronomy area or the space physics area. So we try to make sure that we don't allow inbreeding or just personal knowledge of various people and the investigators become an influence here. Category two, wellconceived and scientifically or technically sound investigations, which are recommended for acceptance, but a lower priority than category one. So category two means if you don't have a category one investigation for a particular part of the program that you want to select, you can select a category two investigation, but category two cannot displace a category one, even if it's lower cost.

Category three is something we don't invoke very often, and it was used much more often in the early days of NASA, when, in fact, people had great ideas for investigations, but we didn't know how to build the hardware. Those of you who have been around will remember a lot of the stuff back in the early days of the technology. Detectors and everything else were very crude by any standard we have today, and so many times, we'd say boy, this is a great idea for an investigation, but we don't know if this camera will work or if this spectrometer can be built, so it would be called a category three. And many times it was funded for technology development and then picked up for later flight opportunities. We do occasionally select a category two but not too often.

And finally, category four is a proposed investigation to recommend it for rejection, for the opportunity, whatever the reason, and it can be any reason. It can be too expensive, it can be too heavy, it needs too much power. It could be that the science objectives weren't well enunciated. It could be the science team isn't the best we think it ought to be. It could be because there's a fundamental flaw in the technology that's proposed, and I have seen this happen.

I have seen an otherwise excellent investigation, because it left out the filter that everybody knew had to be in that experiment to make it work and it got left out, that was enough to cause that investigation to go from what could have been a category one to a category four. One principal point in all of this process is you can never add something to an investigation. If it's not in the proposal, it's not in the proposal period.

However, if something is in a proposal that we don't particularly like, for example it got too many team members or they add on an extra little piece of hardware that we don't think is necessary, we can make a recommendation for descoped investigation to be selected. And in a case like that, you would evaluate the proposal as proposed, and it may be a category two, but if you take something out of that proposal, it can bounce up and become a category one. That doesn't happen too often, but it has happened, and that's why sometimes you'll hear the talk of a descoped investigation. In fact, there's a provision in Appendix A of the AO, Section Two, I believe it is, talks about the potential for descoped investigations.

Okay. Any questions about categorization?

(No response.)

DR. BOHLIN: Okay. And once the categorization is done, it gives the program scientists a subgroup of top-ranked proposals to use for putting together recommendation for selection, and that recommendation is then reviewed by the

Space Science Steering Committee, which, again, is an internal committee of civil servants from the Office of Space Science assigned by the Associate Administrator. I happen to be the chairman of this committee and have been for about the last five years or so, and it meets in session. It has a minimum quorum of four members plus the chairperson. Its purpose is to review all the evaluation processes and records to ensure their compliance with the federal regulations, which is NASA FAR Supplement 1872.

By the way, this document, if you print it out, runs on about 55 or 60 pages. It's about as turgid a read as you will ever find. I often make the analogy it reads a little bit like Leviticus from the Old Testament, thou shall do this and thou shall not do that. It's not very much fun to read, but, nonetheless, that is the law and that's what we're required to follow.

And if the inspector general ever walks into my office, and that's happened once or twice, it kind of ruins your day, looking for waste, fraud, and mismanagement, the standard against which we are being judged is that document right there because that's the legal controlling document.

So we review all the processes and records. We want to make sure that everything is there that we think needs to be there. We ensure the evaluation process for all proposals were conducted fairly and evenly, that's a big factor for us, and to ensure that the quality and completeness of the documentation substantiates the categorization findings.

In a very real sense, the Steering Committee is doing what the Associate Administrator would do if he or she had nothing but two or three days to go through a vertical foot of paper, and that's, typically, what we're looking at at this stage of the game for any number of proposals. The composition, as I said, is an independent panel composed of civil servants appointed by the AA, none of whom participated in the evaluation or the categorization process, so we're looking at a fresh group of people here.

The product of the Steering Committee is a statement of findings as to the fairness of the process and completeness of the records with a directive for corrective actions, if required, and a verification of the category one or two candidates for selection, and so there's a relatively short memo, typically a couple of pages in length, that goes to the Associate Administrator. I deliver that at the selection meeting itself.

Basically, it's the Good Housekeeping Seal of Approval on what has transpired, or if the committee has detected something that maybe does need to have special thought, special consideration, then we call that to the attention of the Associate Administrator so that the AA is not blindsided by something because once the AA signs the selection statement, then he or she is legally culpable for that, and the best way I have of demonstrating the value of this process is imagine yourself as the AA, and you have in front of you a selection statement, which is going to commit maybe as much as a half-billion dollars of American taxpayers money, and you are being asked to sign that piece of paper. You'd like to know that everything was in order, and that's what the Steering Committee tries to do.

Okay. Any questions?

(No response.)

DR. BOHLIN: Okay. Thank you for your attention.

DR. GARVIN: Thank you very much, Dr. Dave. Well, we've heard from Dr. Dave, and I think we're, roughly, on schedule, and I'd like to introduce Joe Bredekamp to talk about the data archiving and Planetary Data System aspects, and then we'll cut to Rich Zurek to talk about the specifics of the mission science.

Joe.

MR. BREDEKAMP: Thanks, Jim. I appreciate the opportunity to be here today and try to heighten your awareness to one particular topic, and that would be data management archiving.

The messages I would like to leave is give you some background and sensitivity to our philosophy and objectives and policy with respect to data. The reason we fly these missions is, obviously, to take the data and to utilize that data and to extract from that data scientific understanding. It is one of the key assets in our process, so I want to share with you the background for what we're trying to do, what our objectives and policies are, and then give you an overview of the Planetary Data System, which, with respect to the Mars missions in particular, is evolving now, and I'll discuss that just a little bit and then leave just a couple of messages in terms of offering PDS, as a resource, in your planning process.

With respect to the Office of Space Science and our data management practices and policies, the key objective, again, is to preserve and utilize. We take the data to use it, analyze it and use it and extract the science and really treasure that data as a national resource because it truly is.

The other key objective is an open data policy in that the data does belong to the science community and public, and this is done at taxpayers' funding, if you will, and it is a national resource, and it belongs to the science community and public, in general, and not to the individual investigators.

And the other key objective is to assure appropriately balanced allocation of resources for data issues throughout the process. We have had, through history, some less than sterling performance in terms of taking the data and getting it down, so the key point is that you need to deal with and attend to and plan forth the data issues from the onset. It's not an after the fact or once you get it down, but it's got to be a part of the process from the beginning.

The requirements or policies call for the projects developed, project and the management plans, again, up front, and which are part of the new start approval.

And then the other requirement is timely delivery of the data products to the archives for distribution and open availability, and the reason we archive it is not just to preserve it. The reason we archive it is to use it, make it available and use it. The Program Scientists and Project Scientists are the ones responsible for assuring through that process that the data does flow and is available to the community.

Now the Planetary Data System within OSS is probably one of the longest lived, I guess you would say, nearly 10, if not a little over 10 years old now. We have the philosophy within the Office of Space Science, our basic objective is to distribute the data, and we organize our data systems around science disciplines, and so the Planetary Data System and subsequently organizes and allocates around subtopics within these. The Astrophysics Data System we organize around wavelength, so we have that high energy assigned to an archive and research center, the infrared at JPL/Cal Tech, and space physics primarily around the National Space Science Data Center, which has the principal function for tending to the space physics data and making it available.

The other philosophy comes out of the basic CODMAC principles for creating a data management from 1982; I think was the first volume and then a third volume in '86. And the idea of distributed data systems and the science wrap-around and what we call put the data, make the data, make the person responsible for that data and for distributing that data or give that data to the science data lover, if you will. So put it in the hands of the science disciplines, where you have that discipline expertise wrapped around.

So again, the reason we put data in archives is not to preserve but is to make it available and use it, and so you need that science expertise and discipline expertise, that science wrap-around to consult and assure that folks using the data use it appropriately and understand the scientific aspects of it.

Now the PDS, again, is a node structure. I mentioned astrophysics is by wavelength, if you will, and PDS is more topically-driven. And so we've got nodes such as atmospheres, geoscientists, again, very distributed and at, generally, user locations; imaging at USGS and NASA Ames. And then we have some special nodes, one of which is the NAIF, Navigation Ancillary Information Facility, to provide ephemeris and other ancillary data, again, make most use of, if you will, or enable the use of the actual data.

One of the points I want to make, and I was going to go through some more specifics with respect to nodes, but take a moment here because PDS, being the oldest, is involved, and especially as we point towards Mars, in a real mission to Mars and literally in virtual Mars, in that we take and we have a data framework for integrated and systematic analysis in looking at it, again, as a system and having availability to a database, a Mars database, in all aspects.

And again, the missions that we're planning here, the paradigm of the approach we have taken with PDS in terms of the standard, we archive on CD-ROM and are now moving towards DVD, really is not as workable, and we're looking at evolving that process, especially with the Mars missions, looking more towards online access and delivery into an integrated framework that you can have access to the Mars data and that mission, specific instrument and search by that, that you can topically go in Mars data.

So that's how we're evolving, and so the message here is we need to be working, use potential investigators in making the plans. That needs to be worked interactively to get consultation as that approached and particular needs for the data handling from the onset, right through the process, and into the archive. So what we would offer is PDS consultation and also then through the various nodes, not just through the central, where the standards are set, etcetera, but through the nodes themselves, where the scientific expertise is.

It's pdsimage.jpl.nasa.gov, and from there, you can peruse through the nodes and get at, again, consultation through the individual science discipline nodes.

So that's about as quick and dirty as I

can do it. I must admit, Parkinson's Law prevails. Work does expand to fill the time allotted. I've got to be out of here in 10 minutes to catch a flight to Alaska, so I am motivated.

Questions? That was rather compressed. Yes, sir?

PARTICIPANT: Can you comment on any specific polices that will be implemented for Mars missions?

MR. BREDEKAMP: [Drop out] And, in fact, I think it's an excellent document [See draft Mars Exploration Program Data Management Plan in the MRO library]. They did a very good job of capturing the lessons learned in evaluations.

Other questions?

(No response.)

DR. GARVIN: Let me just come back here for a minute. Well, I'd like to turn it now to Rich Zurek to talk specifically about the mission, science traceability, and what we're looking for here, and then I'll take about a minute or two on the science evaluation, and we'll talk about the technology, management and cost evaluation, as well.

Rich.

DR. ZUREK: Thank you. Jim gave you a very good overview of all the science that one could do with Mars. Motivated by what we've been finding with our previous missions, the variety of things that we want to pursue to follow-up is immense. And the task for the Science Definition Team that was formed by NASA was to try to get to what these objectives ought to be for the mission launched in the August 2005 timeframe and take into account the other contingencies, the other constraints that are on the mission with what is available in terms of cost, mass, resources, etcetera.

For the 2005 opportunity, I remind you that we are, for the first time since Mars Observer for the Mars Program, looking at a selection of all the major elements, the launch vehicle, the spacecraft, and the instrument suites all together.

This is another representation of the science goals that underlay the program, and, certainly, MRO will be addressing this by looking at that interconnecting theme of water. Where on Mars has water been? Is it there today? Has it been there recently on the surface in recent geologic time, is what we mean by recently today. And this mission will be addressing that.

They're looking at the climate and the geology of the planet. The information that it would assemble would be used for future missions, both robotic missions and, eventually, to prepare for human exploration, the information that it would gain about the atmosphere. Places on the surface would all be important parts to the body of information needed to prepare, ultimately, for human exploration.

And then, finally, of course, all of these are the context in which the grand question of did life develop on the planet, and if it did, when, and what was its evolution on the planet? If it did not, what were the circumstances under which life did not occur and a process that may occur throughout the universe?

The Science Definition Team was chartered by NASA under the Program Scientist, and was co-chaired by myself and Ron Greeley of the Arizona State University. We were on a fairly fast time schedule. What we were looking to do last December and January was to come to grips with what should be the science objectives for this mission, given the likely constraints, including the selection of mechanics and the difficulty of getting to Mars in the 2005 opportunity.

Now we were able to build upon a body of work, which comes both from the National Research Council's work, particularly its Committee on Planetary and Lunar Exploration, COMPLEX, but more recently on what the Mars Exploration Payload Advisory Group, MEPAG, has done, and all of the investigations that were considered high priority, as based upon those bodies of work that came before.

To make progress, we divided into subgroups looking at particular issues in atmosphere, surface mineralogy, composition, subsurface imaging, gravity, and others. We all came together in a final meeting at Arizona State

University in January to try to come to grips with what will be the objectives for this. That report was submitted to NASA in the early part of February and is available on the network, on the web site.

The SDT came to the conclusion of dividing the potential suite of investigations and objectives for this mission into two groups. Group one had the highest priority, things that were technically mature, likely to make major discoveries, and we also had to consider, within this last definition team [meeting], the context of this mission with regard to other missions that were already flying or were underway in their planning, such as Mars Express and, of course, the Odyssey spacecraft now approaching Mars.

The viewpoint science objectives are, and we'll go through those here, first of all, to recover the Mars Climate Orbiter atmosphere and climate science objectives. These had already, of course, been peer-reviewed and been through the development process. They are what formed the basis of the orbiter portion of the '98 Mars Surveyor

Mission, and, yet, we needed to go through the process of validating and confirming that these still were the highest priority objectives and belong in the group one categorization for the science to be done at Mars. They looked specifically at the investigation from MCO and at the proposed revision for a subsequent follow-on orbiter that is MRO.

The seasonal cycles and diurnal variations are ways of looking at the physical processes of climate change. Those are what we need to understand if we are to extrapolate our experience and our knowledge back into the past to try to understand the climate evolution of Mars, particularly if it is not one of those gradual things that occurs in an episodic way, affected, perhaps, by the very large astronomical variations due to the elliptical Mars orbit.

Other aspects of this were, of course, to characterize the present atmosphere, particularly the transport of some of its key constituents. Dust is sort of the ozone, if you will, of the Mars atmosphere. It determines the atmospheric structure overall. It is variable, though, and highly transient, and it provides, in a way, a natural laboratory for us to understand the kind of climate change that can occur on planets. It has already affected our own context of what that kind of change might be. The fact that Mariner 9 saw, when it approached planet, a global dust storm got us thinking about how similar kinds of events at the Earth might have influenced the development of the planet's climate and its impact, of course, on the biosphere.

That was considered by the Science Definition Team to reconfirm the PMIRR type of investigation of atmospheric profiling at high vertical resolution that added the vertical profiling of water vapor to the suite of investigations that we made previously at the planet, some of which are being made today by Mars Global Surveyor.

It goes further from what the Mars Global Surveyor and Mars Express capabilities are by providing a global sampling at relatively high vertical resolution and gives us an insight into what the water cycle is over the full Mars year of development. And that became then a requirement for Mars Reconnaissance Orbiter to continue to do global mapping, as well as its targeting capability, and to do that for one full Mars year to capture that annual seasonal variation.

Moving on to the next categories, still in group one. We're to search for sites that show evidence of aqueous and/or hydrothermal activity. The key part of this is to do it at a scale that is unprecedented with what we are planning to fly and what we have flown in the past.

We have seen from tests that there is not discrimination. We didn't find the Bonneville salt flats with carbonates laying out on the surface, as we expected, even though there is other evidence of what is on the planet in terms that water once flowed on its surface, but where are these things? They may be at a scale that we have not been able to resolve at a few kilometer footprint to test the experiment. They may not be resolvable even at the hundred-meter scale of the thermal investigations that Odyssey is flying in terms of its THEMIS investigation.

So the Science Definition Team said that for the next class of investigations to go to Mars in 2005, what we need to do is get to high resolution in both what we'll call the imaging spectroscopy and also in the stratigraphy by looking at imaging systems. And that's where the debate about resolution versus coverage for these systems came. The SDT spent a lot of time on that and came to the conclusions that you'll see in terms of the requirements for the investigations spelled out in the AO.

Now finally, another, of course, major activity is to explore hundreds of targeted sites, and there are some requirements that fall out of that. One, no, we're not going to cover the whole planet at this ultra-high resolution. We don't have, even with this very capable spacecraft that we are anticipating the abilities to return all of Mars at submeter pixel resolution. So we're going to have to be choosy about where we do look on the planet, but there are some requirements that we've asked the spacecraft be able to support, and the mission design has been developed in terms of supporting that, as well.

First, we want to be able to look anywhere on the planet, so even though we can't cover the whole planet, we want to be able to target any particular place on the planet, should we decide to do so. (end of tape one) been one of the drivers to the mission design.

The second is that to help aide the high resolution imaging from the spacecraft, and by imaging I mean for both imaging spectroscopy and for the camera, to enable that, you'll see that there is an orbit that has been chosen that gets you closer than our previous spacecraft have been able to do. You'll see an orbit that is 200 by 400 kilometers elliptical, and the purpose of that is to help gain that factor to increase what can be achieved. That also gives a requirement on the instruments to be able to operate at a number of different altitudes. The mission design has chosen an orbit in which that was around the planet, again, to get that global access so that you can get the ultra-high resolution anywhere on the planet.

The differences between landers and orbiters in the pursuit of the Mars Program objectives are really not very different. It's the same science. It's the follow the water theme. What is different is that when you go to the surface, you have the sensitivity that assists you in your sampling activity, experimentation can give you. What you have from orbit is you're not limited to that one site that you went to and the mobility which is still limited, even in our ambitious plans to expand that in the future.

What you have from orbit is the ability to look at hundreds of targets, hundreds of landing sites, and, in using these resolutions as recommended by the SDT, to be able to see them in a way that is almost like you were there with the lander itself. So that ability to target is a very important part of the Mars Reconnaissance Orbiter.

The group two science objectives, these are very high priority objectives. They are put in group two here, not because they are less interesting scientifically but because the ability to do them in a timeframe of the 2005 launch was considered to be either less or that we would need to build upon information that we did not yet have.

Of those, a key one is to detect the presence of liquid water and determine the distribution of ground ice in the upper surface. This emphasis is on the upper surface in contrast, for instance, to what the MARSIS radar experiment is doing on Mars Express, in which case they were working in the paradigm that to find water on Mars, we've got to go deep, kilometers deep, or so for most of the planet, and that instrument was so designed.

We've seen evidence, however, from Mars Global Surveyor in the time since the experimentation was designed for MARSIS in which water might be closer to the surface. Those gullies seem to emerge, if you will, from the subsurface at levels that are only hundreds of meters, not a few kilometers deep, and an investigation that goes to look for those was regarded as highly important in terms of its science.

The use of radar to profile the upper most crust is, certainly, the technique of choice today to go about doing that from orbit. And the issue is whether or not one can do this unambiguously because the other thing that the previous investigations have shown us is that Mars is a very complicated place. We see layering, which is very complex wherever it is exposed, in the canyons or in the craters and such. And the detection of these kinds of things is going to be difficult to do. However, we've got stratigraphy, and trying, of course, to find water in its many forms is an important part of the mission at all levels.

Atmospheric observations, in addition to the atmospheric sounding that is captured by re-flying the MCO investigations, of course, is also important. There are many instrument opportunities that we'll see. However, for this particular mission, the AO reflects the fact that we're trying to emphasize the group one prioritizations and that we're anticipating that the resources the spacecraft has available isn't going to leave very much for these others. As Jim Garvin and others have pointed out, anything that addresses these top-level science objectives, of course, is fair game for the mission. However, in our planning and such, we wanted to give you the guidance that the emphasis is on the group one objectives, and that was the recommendation of the Science Definition Team.

Other characterizations of the planet that are opened up by the mission design that was required to accomplish some of the other group one objectives, of course, is that we can do a better job with the gravity field if we have a spacecraft which is flying in an orbit getting down to 200 to 250 kilometers. We can now resolve scales of a gravity field that we couldn't do before. We can begin to correlate those with the past observations of altimetry and such, but also with the investigations and the things that are reviewed by the investigations on this spacecraft, whether it be imaging spectrometry or just imaging itself for stratigraphy.

And finally, of course, there are opportunities to use radio occultations to profile the atmosphere at very high vertical resolution, even though the way those occultations will come about with occultation from Earth will limit the range of latitudes in places on Mars that those can be obtained.

So that's a very brief overview of the way the Science Definition Team came to and what it recommended and those are reflected specifically in the group one and group two categorizations that you see in the Announcement of Opportunity.

So what's the status of the instrument selections? Jim Garvin went over these. I'll just touch on it again to remind you that there is the atmospheric sounder. It is a re-designed experiment from MCO, that is, it is not the same piece of hardware.

I'll remind you of what Dave Bohlin said about the difference between procurement of hardware and investigations. The Science Definition Team looked specifically at this to see whether or not it ought to be competed. The conclusion was no, it's addressing the same science objectives. It has changed its hardware to reflect the improvements in technology that have occurred since that previous instrument had been proposed to the Mars Observer spacecraft over a decade ago. And the fact that it is re-designed has opened up resources that could be used for other group one objectives, including the solicitations through this Announcement of Opportunity. The MARCI camera systems, that was a dual camera system on the Mars Climate Orbiter spacecraft, the wide-angle camera, that information is still very necessary to give and integrate the information that you get from the atmospheric sounder, so it, too, is recommended for re-flight on the Mars Reconnaissance Orbiter.

The medium-angle camera, which was a multi-spectral camera devoted to looking at the surface and many visible spectral bands, was not because many of its attributes are already built into the THEMIS experiment, which is on the Odyssey spacecraft approaching Mars and will be returning data from it.

Instead, we're going to use the opportunity of swapping out that camera, and we will look at it to see if that is the best implementation of a context imager that would be used to support the high-resolution instrument. That context imager is just that, a facility instrument required to support the high-resolution instruments, and by that, both the camera, again, and the imaging spectrometer.

An opportunity appeared to fly a radar, though we may not have been able to accommodate otherwise, by the provision from a foreign partner as part of a longer term agreement about capabilities to be developed in the Mars Exploration

Program. Provisionally, this is still being worked, but provisionally, the Italians will provide a 20-megahertz radar that will sound the near surface of the planet. There is a brief description of that in the PIP, and that information is provided so that people proposing to be team members of that radar facility team will have an idea of the capabilities to be pursued by that investigation.

Then finally, we have the instrument selections, which the SDT emphasized ought to be principal investigator supplied, and these are the visible and the infrared imaging spectrometer. Again, the recommended resolutions reflect the range of altitudes that were presented in the mission plan, which we believe are achievable, get down to resolutions that are unprecedented for Mars observations. And so now we're at the scale of the Yellowstone Hot Springs rather than looking for the ancient salt beds of ancient seas.

High resolution imager is also unprecedented in its scale. There was a lot of debate in the SDT about whether we should go for courage or for resolution. This was agreed upon as going way beyond the MOC capability and to give us insight every time we have had this order of magnitude increase in spatial resolution with imaging systems, we have found a new Mars lurking out there. The question is will we find that again? And, of course, we do have the capability to cover more space at lower resolution just as MOC does on the Mars Global Surveyor spacecraft. Not all those images are taken at that best resolution of 1.5 meters per pixel, and we would expect that there would be some range that would be provided here. However, because it is such high resolution, we have gone to the trouble of insisting that there will be a facility context imager to support these investigations at these very high special resolutions.

And as was mentioned, the other facility science teams are contingent upon, of course, that we really do go down to those 200 by 400 kilometer altitudes once we're at Mars, and that we do, for instance, in radio science, if there's a need to use an ultra stable oscillator. Presently, there is one in the package that will be used to support future landing missions through a proximity telecom link that is relaying data from the surface back. That's a tremendous enhancer of science overall, but it's done in the context to support future missions.

If the radio science investigation requires that, but we decide not to fly that, of course, then we would have to revamp or descope those investigations.

Now in the specifications that were in the Announcement of Opportunity, there is one that might have been rather confusing. It was rather incomplete. It stated to be for the visible near-IR imaging spectrometry 10 wave numbers. Well, if you just say 10 wave numbers, that ends up requiring a resolving power at .4 microns of like 2500, and that really wasn't the intent of the SDT.

What I've done here is to copy out what the SDT recommended in its report and a more complete specification really is that 10 nanometers at a wavelength like 2.5 microns. But let me remind you that the purpose of these are to find the aqueous minerals and to be able to identify it. Don't lose sight of what the objective of the investigation is here. That is what the SDT felt would be required to unambiguously retrieve, if those minerals are present on the surface of Mars, to be able to identify them from orbit.

Let me just remind you of some of the science attributes of the Mars Reconnaissance Orbiter. It has a mixed set of observation modes. It has instruments that will be looking at the planet globally for a full Mars year. It has instruments that will want to do regional surveys of parts of the surface. The context imager could be used to look at other areas, where we're not, perhaps, interested in the highest resolution but are looking more for coverage to try to get, if you will, the scientific context of a more extended area.

The radar will be looking at areas, and we could anticipate what some of those areas might be looking at the highlands where those gullies seem to emerge from craters and such. Look at the northern lowlands, incredibly smooth, where we might find buried ice beneath those northern plains.

And finally, we have the targeted high spatial resolution observations, which are going to be covering very small areas of the planet, and we need to choose those very carefully.

You'll notice in the Announcement of Opportunity, there is a discussion about the process by which the Project will be working and the choice of those targets, and some of those targets will be specified, of course, in support of future landers. Others will be a derived as NASA decides to do for programmatic reasons, including outreach reasons. A majority of those, of course, would still be at the selection of the investigators on the Project. We'll see that happening through a teaming process coordinated within the project science group as a way of choosing the sites validated by the overall program requirement.

And finally, the spatial resolutions, of course, are unprecedented for Mars missions, and we have gone to some lengths in the mission design and in the spacecraft specifications to be able to ensure these a near polar orbit with a rotating periapsis. You'll hear more about that later today.

There is a requirement on the spacecraft to be able to look other than just beneath the spacecraft. However, in trying to control within the cost and mass envelopes of the spacecraft, we have not asked the spacecraft to do complicated maneuvers on the pointing. The idea here is that even the cross track viewing would be done by slewing off, holding the point, so that you get a stable direction as you're trying to take your observation with the high resolution instruments.

These high resolutions, enormous data volumes, we're talking, in this mission, about tens of terabits of information returned. And even then, we're only covering a very small part of the planet at this incredible resolution, and we'll have to choose carefully.

The data return rates still determine the total number of sites that we would be able to observe with this targeted observing mode and, ultimately, the fraction of Mars that's covered. Flexibility in making those choices of resolution and tradeoff is one of the things that we look for in the investigations.

Okay. That's a quick read of how the Science Definition Team's recommendations have now been translated into what you see in the Announcement of Opportunity. And we can take questions later in the day, if there are specific questions about that process, or points of clarification about the objectives themselves.

Jim, I'll turn this back over to you.

DR. GARVIN: Thanks, Rich. I want to amplify that in the question session later, please don't be shy.

What I'm going to try to do now, very briefly before I turn it over to our colleagues from Langley, is talk a little bit about the science evaluation that goes together with the mission description that Rich gave at a very quick level, so that we can then talk about the outreach and the evaluation for the technical management and cost.

So I'm going to do this briefly. It is described in the AO, and I'm going to amplify a few points. There's a few ground rules that are vital that you understand because science is, as you can see, first amongst equals in the evaluation. So for the purposes of the science evaluations done in the process that Dr. Dave described, and I'll go back over in a moment, these are the relative ratings that we have, and I'll amplify on what these things mean. You can see for both the principal investigative instruments, the ones that Rich described, and the facility science teams, the overall merit, again, I will amplify that as weighted at 35% of the overall science score.

The, basically, technical merit and feasibility, the ability to implement it on the maturity levels that fit the schedule we have available is 30%. That's, can we do it? This is what does it do. The risk, schedule, margin, costs, resource, of course, and then the overall quality, integrity, capability, and experience of the proposal. So these are traditional ratings. These will be factored in, again, to the science evaluation.

I'm just going to come to this one more time and remind you of a couple of things. Dave went over this but a few points about the science. We will be using external mail reviews for the science. That's what you see here. They will be done externally to contribute to, as well, the science panel that will be meeting in plenary here and using the input of the technical management and cost panel together to produce the information necessary for that categorization that they discuss.

So this will be a meeting of science peers, I'll talk about what that means again, many of you are familiar, which will build from the external mail in evaluation and the evaluations done by that panel itself to reach the kinds of voting and scoring that will be used in making this categorization, which, of course, will include these factors all together. I wanted to point that out.

And let me go on in the interest of time. So what are the criteria, and I apologize if this is a little bit hard to read, but I'll take some time. I think there's a couple of points I want to make about the actual evaluation factors that are very important, and they follow directly from what the Science Definition Team discussed at great length in their deliberations.

First and foremost is merit, and merit means many things, and we all know it at the level of data analysis investigations. But in the case of this mission, I think it's vital that the proposers for the instruments and for their facility science teams demonstrate quantitatively a traceability to the objectives with respect to their hypotheses. Just restating that is not enough and will not constitute a high merit score. That's the first thing. We want to see that traceability to the specific type of hypotheses that are tested with the measurements that are proposed. So that's one thing, and that would be a very important point.

Secondly, and this is one that I feel most strongly about, the Science Definition Team in the AO have gone to great trouble to define the kind of things we would like to be able to measure and why they're important, and that's great. I think it's very useful.

The next step is, actually, explaining relatively what we think we know now against the backdrop of Mars Global Surveyor and modeling work, what the gain in knowledge might be from the successful measurements made by the investigations. In many ways that can be done.

In some cases, I refer to that as the one over zero case, where we don't know much or think we don't, and we make a fundamental measurement of a state variable, there's many cases, and we increase what we know effectively. We now have a new perspective. And we would like to see that quantified in terms of the science merit evaluation factor, and the science panelists will be given typical forms to guide them in evaluating the investigations this way, so this is very vital. We want to see some quantification of what we're doing. So that's the first two points I'd like to make.

Secondly, in the area of the doability, the technical merit and feasibility, there's, of course, a very big challenge in this mission. We don't have a lot of time, and we would like to make it very clear to the investigators that there is a mission constraint box, and, obviously, to do better, we could use more resources, and, eventually, we'll get to the point where that will be a risk factor, and that's one of the things about the doability that's very important.

We recognize on this team, I think, the challenges faced by trying to achieve the kind of numbers that Rich showed for the available resources, and so we need to see, in your development of your proposal, how you'll meet those challenges, where the puts and takes are. That's very important. Of course, these are standard, and I think in the case of facility team members, we would like to see a hypothesis-based testing investigation proposed and the specific role of the investigator, the facility team investigator and, in some cases, team leader to that.

And this is not just the motherhood that we all can write but specifically what one would do as a shallow sounding radar team member to better develop the instrument toward making the measurements to facilitate the investigation. It's very important.

The others are fairly standard, I think you can see. And the technical management costs will be described next, but let me just spend the next couple of minutes and summarize how the process will work, so you all know what we're doing.

We, of course, will receive the proposals in the end of August. We will sort them and mail them to experts. I'll talk about how we will assure a non-conflict, both institutionally and also assure against what I call the negative conflicts that occasionally occur.

These will be mailed in. They will be submitted before the physical science panel meets. Panel members will, of course, all be vetted for conflicts. They will meet as a function of the instruments, and then subpanels for the facility science teams and the experts in those areas will actually review their peers. We will then have a series of meetings so that we have a broad perspective view by the whole science evaluation panel of the findings. This will lead to scorings of those panels. There is a feedback group, where when the plenary meets, there are issues, issues that might reflect knowledge of some of the other panelists. This has come up in many cases.

Some of them are technical issues about whether we can actually make the measurement at the level. That will lead to a feedback, and, eventually, we will have rolled up through a series of forms consensus evaluations, which will be the basis of the science input to the categorization. This is all documented, as they have mentioned.

Let me just make a point that is very important legally, and I think we all know this. We will go to great pains, and this is a challenge to us working with you, to see that we have non-conflicted evaluators, both in science and technical management and costs. In this case, we want to use the best and brightest of our Mars and Planetary Science Community, and this is vital to me, so we will work very hard, from the available population of people, find these colleagues that we'll work to evaluate. We will go to areas where we know there are no conflicts, like other federal agencies, Air Force experts, as mentioned before.

We will also use the external reviews to capture other dimensions of the review they may not have. They will not, of course, be there [at the panel]. But this will be a very vital part of my job to ensure this compliance and non-conflict.

Those conflicts go as far as people reviewing things from their own institution, multi-leveled, any sense of conflict, even the conflicts that arise when graduate students and their mentors are involved we have to guard against.

Anyway, we will work for a consensus. The whole panels will decide. We will reach majority decision votes, and we really want, I know this is a big challenge, for the final evaluation scorings to be, essentially, a consensus view. And that's very vital to us.

We will document, for the purposes of debriefs, for the purposes of discussion in the categorization, a series of strengths, weaknesses, and for those of you that have been to business school, they're often referred to as the SWAT method, so we will document strengths, weaknesses, and even opportunities and threats that would challenge the missions. These will all be available.

This is the science process. What I'd like to do now is turn it over to, I think, Duane is here from Langley. I should just take it? Okay.

I'd like to talk about this key factor. This is the other aspect of the feasibility, particularly, in this case, for the physical hardware investigations, and let me then quickly turn to that. I'll just go over it briefly, and you can ask questions.

So Dave Gilman, our colleague from

Langley, unfortunately, is ill, so I'm not Dave Gilman, should you have chosen to think that I underwent a change here.

So let me talk about the TMCO, and Dave talked about it, as well. I'll just talk about the scoring. This is an independent panel that will assess, using consultants and retired NASA people and civil servants, the technical merits, the management of the process, and that may be very vital in the case of developing these new instruments on a short time fuse.

So the first thing and foremost evaluation criterion for this TMCO panel is the implementation risk. And we will use cost modeling approaches, which are available, and it will be documented and described to come up with independent cost estimates to be evaluated against the proposed numbers by the proposers. And that's very important, and, of course, that only applies to the PI instruments.

There's also the ability for the proposers to demonstrate, again, a traceability of performance levels in hardware now, not just in the science.

We're going to use this traceability here, as well, and that is factored against the challenges of the cost and schedule, so these are coupled factors. The particular proposers are required to document how they've done their cost modeling. This will allow us to have insight into differences that may occur, sometimes always occur. And some of the aspects that will be reviewed are also a validation that, in fact, the instruments, in this case, can be built and some evidence that the implementation pathway can be achieved. These are very traditional. They've been worked before for many Office of Space Science missions. We will follow these criteria. They will be documented again both in terms of strengths and weaknesses and other assets.

I think it's very important, again, just to remind you that the evaluators here are guaranteed, as best as we can, against conflicts. They will reflect people, usually, who are special contractor consultants with experience in the instrumentation areas that are being considered, as well as in the management of development of space flight hardware, and they come from a variety of places. We've used many of these people for Discovery and Explorers.

We will use peers. People that have built high-resolution imaging systems will be used to help guide our understanding of these. There will, obviously, be at least two and, in fact, in virtually all cases three or more evaluators in every area.

I just want to make one point here. In many cases, we have brilliant science proposals with wonderful technical presentations of their implementation, and we then run into the typical challenge that, well, to put those two things together on the spacecraft that's going to a place like Mars, doesn't work. And that always comes down to management, and one of the reasons we spent a year replanning the Mars Program was to, hopefully, engage in better management principles.

So the management part of your proposal is very important. We have very aggressive build schedules. For any of you that went through the challenges for the MO to MGS scale, where we're rebuilding, essentially, investigations, these are new builds, and there's not much more time. So management will be paid very careful attention to. We will have management experts in building space flight hardware.

The findings, of course, the proposals are evaluated. They also are evaluated by mail-out before the panel physically meets, so we have time to write down adequate documentation by individuals. Every single proposal will be discussed openly by the entire panel. There will be no exceptions to that. So everything will get the same amount of airing. There will be a consensus rating developed. The scores will reflect, of course, the kind of things I've described before. And these will be rolled up together, separately from science and the TMC panels together to form the basis for the categorization.

I'll just go over the process again, and then I'll finish by coming back to that, to remind you of what's happening.

So this is what will happen. Panel members will submit evaluations to discuss some of them in telecoms before actually meeting in person. Typically, these panel meetings last a week, and they'll review all the evaluations. There will be cross-fertilization between the TMC panel and the science panel, so there is some degree of communication. So when, for example, an expert in science instrumentation will sit on the TMC panel, a non-conflicted expert, so there is some cross-over basis. We've used that before to great success, and I think we'll be using it again.

They will assign and document everything. The consensus evaluations will flow. The TMC panel will then come together with the science plenary. We're imagining these happening, essentially, in the same week to two-week timeframe. The deliberation then, the separate group will take over documentation culminated by these groups and categorized, which will then allow an accommodation by the Project and the evaluation by myself as the basis of a recommendation that will be made.

So that's the process. Independently, and Jeff will describe this in a moment, is the education and public outreach point, as Dave said. That's another key variable. It's weighed separately. It often has occurred in cases. It's been a tie-breaker. We'll also evaluate the new technology, as well as the small disadvantage business aspects in that separate group.

So I'd like to turn it over, if I can go back to our schedule, I'd like to turn it over to Jeff Rosendahl, our head of Education and Public Outreach for the Office of Space Science now.

Jeff, let me give you this to comment on that.

DR. ROSENDAHL: Okay. What I'm going to do is give you a lightning tour of what some of our expectations are and where we're coming from in the whole education and outreach program. Just as importantly, perhaps even more importantly, some of the resources that are going to be available to help you put programs together. We have, in fact, put together a number of resources that are available for assistance.

While doing this, first of all, and I think all of this is captured in this photograph, which was actually taken in Birmingham, Alabama at the opening of the Mars Quest Exhibit, which is particularly relevant. This is a national traveling exhibit that's been on tour since last fall, and I think the expression on this little girl's face, basically, says it all.

What we're really trying to do is to provide broader benefits to the people who are actually paying the bills for these programs than just articles in Icarus or Astrophysical Journal or transactions of the AGU.

By the way, another example, Mars Quest just opened on the first of June at the Tucson Children's Museum. It's actually being displayed in Parkway Shopping Mall in Tucson since the Tucson Children’s Museum didn't have 5,000 square feet for this exhibit. And lots of scientists in the Tucson community are participating in public events, public lectures, and a whole range of things. This is all part of a whole suite of activities that we now have underway within the OSS education program.

What we are trying to do is to tell the people, work with teachers and students to enhance the quality of education, particularly at the pre-college level, and work towards creating a 21st Century workforce, which has a number of dimensions to it, one of which, of course, are the usual kind of thing that we have been doing in training and supporting graduate students and post-graduate education.

But there's a second element which is really associated with the fact that this country is in the midst of a very profound demographic revolution. There are lots of statistical trends. By 2030 or 2035, thereabouts, there will be no majority population in the United States. Right now, the vast majority of scientists and engineers are coming from a very narrow segment of the population, usually white males. And the fact is, if we are to continue to meet the demands of the requirements of this society, which is a society based on science and engineering, we damn well better, as a matter of urgent national self-interest, start to attract scientists and engineers from segments of the population that are now not going into science and engineering. And so this is why we've put a particular focus in what we've been doing in working with what we call under-represented and under-served groups.

Where are we now in this whole thing, just to give you some context, and I think I can make a very simple statement and document it. First of all, OSS is serious about this. We are very strongly committed to putting together a subset of education and outreach program and contributing to pre-college education and the broad public understanding of science, mathematics, and technology.

We now have underway what I think is probably the largest or one of the largest single programs in astronomy and space science education in the history of the world. This is actually becoming increasingly documented.

We've put out a couple of newsletters. We've got one now underway, aiming towards September. You can pick these up through the Internet. You can ask me. We put out the first annual report back in January. This is searchable online, it's keyword searchable. This is as much a resource book, for everyone concerned, to find out what's going on, to find out who some of the players are, and so we're putting out lots and lots of information, just to give you a feeling for the scope of the program, and my take is this first annual report, and we're right now putting together the machinery to generate the 2001 version. We probably caught 50 to 60% of what's actually going on. The next version is going to be about three times thicker because we're going to capture a lot of new stuff.

But in addition to well over a hundred products that were produced, many of which were not captured in the online education resource directory that we have made available as a service to the community as a vehicle for capturing the best of what's going on, we identified 1500 discreet events that took place in all 50 states across the country. Many of these were workshops. Many of these were speeches, and some of them were an appearance by a major exhibit. We now actually have four major traveling exhibits touring the country. Now there will be, in the fall, opening two more, one of which is going to be a scale model. It will make its public debut October 17th. The back-up Hubble Space Telescope mirror that will be the centerpiece of the new Explore the Universe exhibit.

Perhaps more important than all of this, and, again, this is a vast underestimate, we identified more than 200 partnering organizations. I think we're going to start to see more like 500 that are already working with us across the country, ranging from major national professional societies like the American Association for the Advancement of Science, which is leading a consortium of 13 educational organizations that are responsible for the Messenger Education Program, with the participation of every scientific member of the Messenger Scientific Team and the Astronomical Society of the Pacific, to a network that's been put together of something that's now approaching 150 small science museums, planetariums, and libraries that's been working with Nancy Leon and the space team at JPL and virtually every stop in between. We are involved with hundreds and hundreds of groups at this point.

Okay. Turning from this general background, very quickly I'm going to remind you of a couple of things and how to get some further information.

First of all, there are two classes of investigations of a very different scientific scale and scope. What we have done to try and tailor this announcement was to recognize that because of the two classes of scientific investigation, there are really two kinds of participation that we're looking for in education.

The PI instrument investigations that we just discussed by Rich will be required to include an E/PO component as part of their overall proposals. We expect adequate resources. We have given guidelines in the AO. It's one- to two-percent of the total investigation cost. In the case of these investigations, depending on which one it is and how ambitious, that could be something in the order of a half million dollars to be spent on education. We will evaluate that as part of the TMCO process. We will bring in a professional panel of educators. The people, usually, we've been bringing in are people who are working with both science and education, so they kind of know where you're coming from, as well, and it will link to the overall selection process. It will not be part of the categorization, so when this thing sits at Ed Weiler's desk, he's going to ask how good is the science, is it feasible, how much does it cost, how good is its education program, and that may or may not play a role. It has in some cases, and it has not in others. We're a science organization. We're not going to drive things on education, but we are serious about it.

One thing that we do have underway is there is a very large umbrella, Mars Exploration Education Program, being put together. I've got a 50-page plan for review on my desk right now. And this will be a program of national scope. We don't want a lot of things operating in isolation. One of the critical things we've done in putting together the whole program is to make sure that we don't all start behaving as if we actually lived in the movie “Groundhog Day”, where the world starts all over again. So we're providing a set of common services. We've been working actively through the support network to provide a whole umbrella approach to archiving and dissemination of educational materials of all types. That's a common service that's available.

Similarly, if somebody has done a national product, they don't have to do it all over again. Take advantage of that, and then concentrate on things that you can uniquely add to the mix. And so we are going to be working for that, and I'll give you some contact information in a couple of minutes.

Facility team members and leaders, we don't expect you to put together an umbrella proposal, the rest of you can go to sleep through most of the rest of this talk, but we are going to expect something else, which is involvement. Involvement in ways that we will make you assist, work with you, at least this large umbrella program, and you can become part of that. You can become a local agent for national programs in your own community. What we're after is really a network of participating scientists. A small investment of time, but you should budget for it appropriately, and we are asking for a statement of commitment just to make sure you sign up for this as part of the proposal.

What are we looking for in the instrument investigations? Credible story containing specifics and commitments. We have found, actually, in four pages, people can put together a very credible story, if they get to the point and don't spend two and a half pages of rhetoric on this. In fact, in cases like Pluto, we had seen proposals, including the two that got selected, that nailed everything they needed to nail by getting to the point in a couple of pages. Letters of commitment, if you say we'll have a partner, we need to know that that partnership is real. A plan that's aligned to the strategy, both of these can be assessed, and I've talked about commitment in the other points and the fact that this will play a role.

We do have some evaluation criteria. The only thing, I will make two points about those. One, both the specific and the general evaluation criteria are very precisely aligned to what we're trying to do in the overall education strategy and implementation plan.

Second, the area is guidance. We've actually put together a document, which is assessable online and it's part of the program library, that actually lays out what some of the markers are that would give you information on what does it mean to actually meet these criteria.

Let me now discuss this, since they're on the AO, because there are some unique things. It talked about coordination. There's contact information from Michelle Viotti. She's going to be the delighted to be hearing from you. The more the merrier, as we put together a community.

We've created a very simple overarching theme for this whole thing. The American public is going to be making an enormous investment in Mars exploration over a decade. We should share the adventure of exploring another planet and make the American public and the world participants in that adventure, and that's what we're really trying to do overall.

We do have some expectations and significant resources. We may or may not put together a large-scale national program. We modified our standard language because of the insistence of this umbrella program to say, look, it would be very nice to put together a regional program because you will then plug in and become part of a national program, and we will take in account of evaluation what you're really trying to do out of all of this.

And we do have a long-range goal, and that is to develop, have the instrument PI's and their teams and the participating scientists and the facility instruments associate in all the individual Mars missions. We want them to become a network across the country of people who can become local agents for national efforts, for carrying out efforts in their own community, so that by the time we get through the sum total of all these individual activities, it becomes very embracing, overarching Mars Exploration Education Program.

We've got lots of sources of information. I mean, we're not trying to leave you here dangling on all of this. One thing we decided early on is if we put in a new requirement, it wasn't adequate to sort of wave at you and say good luck, we'll meet you somewhere, hope you can do this stuff. We got stuff which you can read the strategy, the implementation program, the explanatory guide, the annual report, these various newsletters. This list gets longer all the time. The explanatory guide gives lot of background information, as well as telling you more about the evaluation criteria, and then I've already mentioned about Michelle Viotti.

We've got some sources of assistance. We've put together this national support network some time ago, which there's four theme-oriented education, National Centers for Space Science Education, one of which is solar system exploration, plus a set of people called brokers, marriage brokers in the classical sense, that's where the name came from. People who get the scientists and the education community together and say have I got a deal for you, let me perform an introduction and see if we can get something to strike. These people, the brokers in particular, sole job, primary job is to work with you to find opportunities. They're there to help. They're not there to do the education component of your investigation. We spent a lot of time with them when we started this all up three and a half years ago, working on conflict of interest considerations. Everything that they deal with, with each of you individually, will be treated as proprietary, in much the same way any consultant does business.

And let me just conclude by making some summary observations and wrapping this up. We're serious about it. We do have a major national program now underway that will be considered as part of the selection process. It has made a difference in some but not all. We've seen a very significant evolution in the level of maturity and sophistication and quality of what's been happening over the last couple of years. I will remind you about this annual report.

If you ask me to summarize the situation six years ago, I would have shown a map that had a few little things around NASA centers and not much else going on. We now have, actually, the agency's largest enterprise education programs and something that, I guess, a pre-college education is, actually, comparable to the NASA Education Division. There are resources there, but we also want you to, and this is our long-term goal, to treat education with the same rigor and professionalism as you treat the science and engineering aspects. We're trying to make things very professional, and we're starting to have an effect on that.

And with that, I'll wrap up and thank you for your attention.

DR. GARVIN: Thank you very much, Jeff, and I think we're going to take this seriously. This mission should be a no-brainer in this area because of its potential excitement.

We're a little behind in the schedule, but I wanted to give Steve Ballard a moment, as our international person, to see, in particular, if you have questions or if Steve wants to make a comment about that since, you know, we are an international Mars exploration program, and we don't want to forget that, so Steve, if you'd like to come up, and then we'll break for lunch and resume with the Project and the questions.

Steve.

MR. BALLARD: I'll make this quick. I know you're all cold and hungry.

Basically, NASA encourages international participation in its missions. I think most of the missions that NASA is engaged in today involve some level of international participation. I saw this morning, when Orlando put up the chart, some of the major international components of the Mars Program that we foresee. There are some others that you didn't see there. For example, on the '01 mission, we have French and Russian collaboration. On the '03 mission, we have Germany and Denmark providing instrumentation. So there's a lot of international participation in all the missions.

There are some basic guidelines that we use for international collaboration, and a couple of these I want to highlight. One thing is we generally work with governments. Usually, the level of participation of foreign collaborators are of the level that we have an international agreement with a foreign government or, at least, have an endorsement from a foreign government.

We look for very clean interfaces in the management and the technical aspects of the cooperation. We would like to protect against, we must protect against, we do everything possible to protect against technology transfer that's inappropriate.

It's important that there is no exchange of funds. We do not support foreign nations or foreign investigators, and there is no joint technology development for the national cooperation.

An important aspect of the cooperation, to document it and to delineate it, is international agreements. These define the responsibilities and what everybody is going to be doing and when they're going to be doing it. A major component of the agreements refers to export control. The agreements have general language in them regarding export control, but if it's a major type of cooperation, we have to develop some type of an export control plan. And export control involves the transfer of information or something to a foreign person or you could be transferring something to a U.S. person or company that you know, or have a good idea, that will eventually end up with a foreign entity or government or person.

The reason for export control is for national security reasons, foreign policy reasons, proliferation of missile technology. There is a great deal of reasons why we have export control. You usually think of stripping something out or sitting down and giving somebody some detailed designs or something of that nature, but this gives you a general idea of areas where export control applies and where you have to be careful when you put something on a web site that you're not transferring information or technology to an entity for which you don't have authority.

Export control is if you are going to be transferring any information or involved in discussions or developing something that relates to a project, you may need a license. These types of licenses, generally, are free through the Department of State or Department of Commerce. Some types of activities are exempt from licenses, and we have experts here at NASA that can give you some guidelines on that, and I'll get to that in a second.

QUESTION: What's the schedule for getting a license?

MR. BALLARD: Okay. Let's say for this proposal, you decide to partner with somebody, a foreign country, I'll say Canada. In your proposal, you need to identify all of this information, and this will come to the Program Executive or the Program Scientist. They will notify the Office of External Relations here at Headquarters, and then we will start the agreement process.

From the proposal that you have, you will have an idea of the type of activity you're going to be engaged in. If it needs a license, I'm going to defer up here to export control expert in the back, Ms. Paula Geis. Generally, how long does it take to get a license, if one is needed?

MS. GEIS: If a license is needed, the minimum would be two months, more likely three months, and sometimes it can take six months and longer.

MR. BALLARD: Back to the international agreement, that's prepared by the Office of External

Relations here at NASA Headquarters, and there's a time period, usually, to develop those international agreements. So the sooner we understand that there is going to be some international cooperation, the better. That way, we can get that international agreement started and reach a resolution or an agreement with the partner and have this agreement signed. An international agreement, I would say, generally takes, a simple one, it can take a matter of a couple of months. More complex ones can take several months, and when you're getting into what we call a Memorandum of Understanding, which requires State Department approval, it can take a year or more. But we can usually put what we call a Letter of Agreement in place early while we're working on the Memorandum of Understanding, so that technical discussions and things can proceed strictly during Phase A, Phase B activities.

We have an office here at Headquarters that provides advice on export control, and this is the contact, John Hall, and his telephone number.

An important thing to remember about

technology transfer is that there are criminal penalties, and these then range up to 10 years in prison for the transfer of certain types of data or information or hardware or something of this nature, and anywhere from $100,000 to $1,000,000 in fines.

So export control is extremely important, but we encourage you to talk to international entities about cooperation. In your proposals, explain, you know, exactly what it is, letters of endorsement. All those guidelines are in the AO. We'll put together the necessary international agreements, which are under international law, and then the export control issues have to be addressed during this whole period.

That's it, and it's noon.

DR. GARVIN: Thanks, Steve. What I propose we do take a one-hour lunch break. Let's stay on schedule. 12:45 back here. We'll resume with the Project presentation.

(Whereupon, the foregoing matter went off the record at 12:02 p.m. and went back on the record at 12:53 p.m.)

DR. GARVIN: I'd like to make two comments and then turn it over to Jim Graf and the Mars Reconnaissance Orbiter Project.

First comment is that in the question and answer session, we would request that you state your name, use the microphones, articulate your question, and then after we respond or choose to respond, we'd like you to also provide your question in writing. You can handwrite it, you can e-mail it to us, but we'd like to have the documentation, on the web site, actually, document. They are important for this mission. You can see them. I just wanted to remind you we will be updating these with updates to the documents in the libraries, as needed. And that's where formal responses to all the questions will appear. So if you follow that protocol, we would be very grateful.

So without further ado, we'll turn it over to Jim Graf.

MR. GRAF: Thank you.

Okay. The Project portion of this talk will be divided into three major sections. I'm going to talk about schedules, a little bit about ground operations, a little bit about what our objectives are as a Project. Then Dan Johnston will stand up, and he's going to talk about the mission design. Much of the information you're going to see in his talk and in the subsequent talk from Howard Eisen, in fact, are in the PIP, so we don't intend to belabor it. We want to go over it, tell you what some of the key points are, introduce you to the subjects and move on as quickly as possible and get into the question and answer period.

What are the objectives? We've heard from Rich and from Jim Garvin, but from the Project point of view, we're going to launch in the '05 opportunity a science-oriented orbiter. It's going to recover the MCO investigations that were lost about 18 months ago and add additional high priority AO instruments and science investigations, as defined by you all out there in the AO process.

We're going to do that for at least one Martian year, then during that phase, we'll also conduct site characterization for potential landings, and then we will go into a phase where we provide a relay capability for another additional Martian year.

What is our procurement strategy to the overall Project? It's divided into three major elements. This AO that we're talking about right now will select the major science investigations. Launch services will be competed by KSC NASA launch services contract. The launchers will be an intermediate class. That means they could be either a Delta 3 or 4 or an Atlas 3 or 5. We do not know, at this particular time, what the launcher will be. We are going to work with KSC to help to define what that launcher requirement is and go through that process, but right now we do not know.

In addition, we have an orbiter, RFP, that has been out on the street, and, as a matter of fact, the proposals have come back. They came back on Wednesday of this week, and you're going to hear more about that from Howard Eisen, who's going to talk to you about the orbiter description.

One thing to note on here, all three

elements of this Project are being competed. We don't have any knowns. This probably goes a long way back in JPL and NASA history that a science instrument or program didn't at least have one of these elements known, the launch vehicle or the payload or a spacecraft. But right now, we are working with three unknowns and trying to juggle them. We've done the best we can at defining the interfaces and between the elements and the functions of each element we'll have to adhere to and the requirements that we have to adhere to, but we, in fact, are dealing with three major unknowns right now.

Major instrument milestones. What we have is, and I'll show you a detailed schedule on the next view graph, but a couple of key points to remember is the Preliminary Mission System Review happens in the January timeframe. This is the review that enables us to move from Phase A into Phase B. That will only be about two months after the selection of the winners in the AO process, so we have to be able to get off running and start very quickly.

The second thing to keep in mind is that we will have our Project PDR and confirmation review in the summer of next year, and that transitions us out of phase B into phase C/D. One thing that's important is the instrument accommodation review will happen in the March timeframe, and you'll be participating in that.

What does the near term schedule look like? Our intent is to create the necessary contractual arrangement that we can go out and have a letter contract ready to go as soon as Dr. Weiler makes his decision. We will drop the right names in there and the right companies in there. We will issue that, and that enables you, the winner, to start working immediately on this program. As I mentioned previously, we only have two months to go between selection and our first major milestone, so we want to get you on as quickly as possible.

In addition to that, we will conduct formal negotiations and open up the contract with you. That will be going on in parallel. So we will jumpstart you with a small letter contract, and then we'll continue to conduct the negotiations on the main contract. So issue and selection and negotiations start in November of '01.

We will have three major interactions right after that. The first will be a kickoff meeting. We will go to the industrial contractor site, your industrial contractor site, wherever you're going to produce the instrument, we intend to have a major kickoff meeting on the management and on the technical side, and that will happen in November.

There will be an interface meeting at the orbiter contractor site. This will look at the interface between the instrument, your instrument, and the spacecraft itself. That will happen in the December timeframe.

There will be a Project Science Group meeting, which the PI's will convene at JPL to discuss the science and overall. That will be the first full meeting of the entire Project.

That will be followed by the Preliminary

Mission and System Review, which we talked about earlier in the initial confirmation meeting.

MR. GRAF: Let me move on to mission operations. We're going to have a geographically distributed system involving the instrument teams, the orbiter contractor, JPL, and the various DSN stations. The issue of team responsibilities will be to generate command requests and validate those requests. We've got instrument health and welfare of monitoring and, at the same time, to do the generation of the science data products, their distribution, and their delivery back to the PDS system that you heard about this morning. It is the responsibility of the PI's to make sure that the data gets to the PDS and gets archived, anything that you produce. We will see in the next view graph, there will be one thing that the Project will make sure we get there, and that's the raw data. But it's your responsibility to make sure you do that. It's your responsibility to make sure, if you have Co-I's, that you will be able to get the data out to the Co-I's. The Project will get the data from JPL to your processing site, but then it's your responsibility from there on.

Data levels. This is in the Mars Exploration Program Data Management Plan, it talks about the various levels. Packet data, raw data will be taken by the Project and both distributed to the PI and, at the same time, put into the PDS. So we will make sure that it gets into the PDS.

Yes?

QUESTION: So you are not saying you are archiving packets as opposed to depacketized data?

MR. GRAF: That is the plan right now. And then it's the responsibility of the PI to both generate the various levels that we're showing here and to take the necessary products and put them back into the PDS system.

That was all I was going to talk about. I was going to turn it over to Dan Johnston, and then we can take questions at the end.

Dan.

MR. JOHNSTON: My name is Dan Johnston, and I'm the MRO Mission Design Manager, and what I was going to do is provide you all a brief overview to the mission here.

Of course, our fundamental objective here is to establish a primary science orbit and return the science data from that orbit. The primary science orbit was selected this past January by the MRO Science Definition Team, and it consists of two key attributes. The first one is a nominal orientation that is set at 3:00 p.m. It's our intention to have that 3:00 p.m. orientation fixed during the primary science phase. That implies to us that we will have to have a sun-synchronous orbit here, and if the sun-synchronous condition, that will put us into a near-polar orbit. So the inclination of this orbit will be approximately 93-degrees.

The other key attribute of the orbit is for a low-altitude orbit. Working with the SDT, we came to a conclusion, a realization, that something in the altitude range of 200 kilometers per periapsis and apoapsis of an altitude of 400 kilometers fit that definition.

I'll come back here in a moment and talk a little bit more about the orbit characteristics here, the primary science orbit, but one of the things that's important to realize is that because of the field of Mars, the 200 by 400 kilometer there is outside of rotation that will be induced, and so in terms of the in-plan motions you'll see in a minute, the periapsis moves all the way around the planet in a cyclic manner.

QUESTION: How much of the 200 is in the dark?

MR. JOHNSTON: I don't have that on the figure. Let me come back and answer that question at the very end here.

In terms of our launch arrival strategy, as Jim mentioned, we're going to launch on an intermediate class expendable launch vehicle. Our reference launch period is from August the 8^{th} through August 28^{th}, 2005, a typical 21-day launch period. In order to reach Mars, it's a seven-month transit. This is the type-one ballistic trajectory.

For our arrival period strategy, at final arrival at Mars, we will insert initially into a 35-hour capture orbit period. Because we are planning on using aerobraking in order to reach the primary science orbit, our arrival strategy has to have a node geometry that's compatible with our aerobraking strategies. And so, actually, at arrival or the local mean solar time, the time of the node with respect to the local mean solar time is approximately 8:30 p.m., and because we are very conscious of that node at arrival, we have, virtually, a fixed arrival date time period near the first week of March.

As I mentioned, once we capture, our plan will be to employ aerobraking techniques in order to establish a primary science orbit. Because we are trying to hit this time constraint, aerobraking is a time constraint activity. It does matter the path that we take as we fly down and establish the node at 3:00 p.m. It's not sufficient just to get period reduction. If we get period reduction, getting there, and we're too early, we'll be off our target of 3:00, we'll be at 4:00 p.m. If we're too late, we'll be overshooting at 2:00 p.m.

In order to make sure that we maintain appropriate spacecraft margins, we've allocated a duration of six months to complete aerobraking. This also fits with the fact that during the 2006 time period, the solar conjunction occurs pretty much during the month of October here. So we want to arrive at Mars in March, we want to do aerobraking, and we want to establish the primary science orbit prior to solar conjunction, and then science data collection, once again, until we do establish the primary science orbit.

The next chart shows the characteristics of the primary science orbit, going back to what I was talking about at the beginning. It shows three orbital parameters here. The bottom is the latitude of periapsis, and as you can see, the range is all the way over the planet here, following the pointer here for a second, starting at zero degrees would be the Equator, down over the South Pole, back up to the North Pole, and then back down to the Equator again. This cyclic motion, again, is induced by the gravity field, and it's approximately a 60-day cycle over which that occurs.

The big yellow bar here shown is the solar conjunction time period, so we want to finish our aerobraking activities up here to the left of where this plot starts and into our science orbit right through solar conjunction and then be ready to come out after conjunction and commence science operations.

In terms of periapsis altitude, which is the red chart here, and apoapsis altitude, the green figure here, you also see the comparable 60-day cyclic motion here. That is induced by the gravity field. And so even though it's 200 by 400 kilometers, there is a significant variation in the 200 kilometers. 200 here is a minimum, which is where we've kind of pegged the minimum altitude, up to something like 250. On the apoapsis side of the orbit, we've pretty much decided that we would initially have a 400 kilometer, basically. You could almost call it a mean apoapsis altitude of 400 kilometers here. And so there's variation above and below.

Again, the motion here is cyclic again. As periapsis moves around the planet, the perturbations, both of those factors work to produce the signature that you see here.

And again, in the AO, it's required that instruments are able to operate during this whole time period, anywhere from the 200 kilometer altitude all the way up to the 400 kilometer range.

Now as periapsis moves around the planet, it will go into daylight and darkness. And again, it's going to depend upon the seasonal variation how long that darkness is. I don't remember a number off the top of my head. I could probably back something out for you in a second. We'll come back to you at the end here during questions and answers.

So the motion is different. This is a significantly different orbit than what you see in the previous Mars Orbiter missions. As an example, MGS is flatlined in a frozen orbit that has a minimum periapsis of 370 and it's flat. Its apoapsis altitude is at 430. And so this opens up the opportunity to get high-resolution data by having this periapsis down low.

For terms of science data acquisition and return, as Rich mentioned earlier, this is a hybrid mission conducting both global mapping, regional surveys, and targeted surface observations, global mapping through the climate mapping, re-flight of the MCO investigation, and then targeted observations and regional surveys through the use of the high-resolution imager, the visible infrared spectrometer, and the radar, as mentioned earlier this morning.

To acquire data, the science instruments are planned to be nadir-oriented all the time, and then in order to enhance the surface observation capability, we plan to be able to cross track slew to 30-degrees. So we're not looking at targets just underneath the ground track or along the ground track. We want to be able to slew the spacecraft, with respect to a cross track position, and be able to look at targets off to the side.

For science data return, the orbiter telecom system has a capability of 280 kilobits per second for a maximum Earth-Mars range. We plan to return this data to the DSN during two eight-hour DSN passes, 16 hours per day on the DSN, and we plan on using the 34-meter subnet, and during this time, we'll return something like 10 gigabits per day at long range and, during shorter ranges, something like 100 gigabits per day. So considerable data to apply and to return.

QUESTION: 70 meters is a no-no?

MR. JOHNSTON: We're not planning the mission on the 70 meter.

Following the completion of the primary science mission, which is in one Martian year, the spacecraft will go into a mode of telecom relay and support for follow-on missions launched in '07 and '09. During that same period in time, science operations may continue, if this is approved as an extended mission. So there's an extended mission option there, if that's approved.

At the end of the relay operation phase, the spacecraft has to be compliant with planetary quarantine requirements, and so we are planning on boosting up the altitude from the 200 by 400 to something like a 430 kilometers orbit, typical range where quarantine requirements are satisfied.

That's a brief overview of the mission. Howard Eisen's going to talk next.

MR. EISEN: Thank you. Okay. I am just going to spend a very few minutes giving you the status on where we are in the orbiter.

We are in the middle of the procurement of the orbiter. We are in the middle of an RFB process right now. We did receive proposals last Wednesday. We received multiple proposals. We cannot tell you who's involved in that evaluation, but I can assure you that there are people who work with Rich and people who work with Bill who are part of that evaluation and are looking out for the science and payload interests.

We have imposed on ourselves the requirement that no one who is involved in evaluating those proposals is in any way involved in preparing a payload proposal, and we have conflict of interest statements that people are signing to that effect.

We are expecting a selection in the September timeframe. That means we will not know who the orbiter contractor is until after you submit your proposals. Because we're in the middle of an evaluation, we will not be able to release any more information about the orbiter design between now and September. So all the questions about orbiter capabilities that are beyond what's in the PIP, we really can't answer because I don't know if those capabilities will be there or not. What's in the PIP is what we ask the orbiter contractor to provide, and we don't know yet which design we have, so we don't know what those capabilities will be.

But we will use Phase A in order to refine those requirements, work with you on these things, and Phase A and B will include the development of the ICD's. As we said shortly after you're on contract in December, we will have the first round of interface discussions, and then we'll have an instrument accommodation review early in Phase B.

The PIP has the payload accommodations, but I want to point out the numbers in the very first bullet here are not in the PIP, but we thought you would find them useful. For volume, as you've seen in the PIP in the reference diagrams, there may be more volume available than what we had suggested to the orbiter that you may need. You should propose what you think you need in terms of volume, but in terms of what we will be looking at, at accommodation time, we have given these referenced dimensions here to the orbiter proposers in the RFP and told them to start with this. You are not constrained to this but understand that's what they working to.

Similarly, the math and the data numbers here are also what they were given or they were given this plus margins. And so all these numbers here are taken straight from the PIP.

Last, the PIP includes a large number of deliverables, but I wanted to highlight some of the major ones, the ones that, of course, I'm concerned with over on the orbiter side. As part of the development process, there are hardware and software development deliverables. On the hardware, we've asked for a fit check template, so we can make sure that, mechanically, the payload will fit appropriately. We've asked for a payload interface simulated just so we can check electrical signals. And, of course, we've asked for a complete engineering model with ground support equipment. That way, we can take the payload early on and incorporate it in the orbiter test to check all the functionality.

Similarly, on the software end, there's thermal and structural models that we need to integrate into the orbiter design. There are software loads, calibration data, and sequences for mission planning.

On the flight deliverable side, of course, you're delivering the flight hardware and software sequences, flight rule constraints, and everything has to be delivered with the appropriate documentation to match a product assurance plan.

That's all that I had to say. The rest of the package that you have contains Bill's response to the questions that were submitted prior to the 11th. We're not going to go through all those here, so please take a look at those. If you have any specific questions about them, we can go back over them.

I'll turn it back over to Jim for the Q and A.

MR. GRAF: There is something very different about this mission, and we tried to put it down on one chart, and I'm going to try this out. It's the first time, I think, it's seen the light of day.

The blue represents the amount of data that we will produce out of MRO in one Martian year. It's 25 terabits. And the other spheres that you see up there, circles that you see up there, in fact, represent the data that you get from other missions, including Magellan, and you can see that the amount of data, the amount of bandwidth that we're looking to provide to you is dramatically increased over what other missions have provided. And that is to enable both the high-resolution and the greater coverage of these major instruments that you're about to propose on.

So we're going out of our way to try to get the bandwidth up so we can get the coverage up, get the resolution down, and this is what's resulting from that. So I'd thought I'd leave that with you.

Thank you. Jim.

DR. GARVIN: Okay. Thank you. And I just wanted to echo what Howard just mentioned. In your packages, I hope everyone in the room picked one up. They're outside on the table as you were walking in next to Sue. Sue's up front. She's with NASA Peer Review Services as one of the people helping make this conference happen. But please pick one up. We have responses in there that have been drafted by the Project to the questions that were submitted by the close of business, I guess, on the 11th.

So what I'd like to do, in the following format, is turn open this bidders conference to questions, in particular points of clarification, and together, our team at JPL and here at Headquarters will, in an effort to answer your questions or we will follow up with a formal response in writing, should you submit it. There will be some that, of course, we will try to fend in real time.

So let me open it up for questions. First question, if you could stand up and identify yourself.

QUESTION: I think I detected a conflict in what Jim was saying about the Project to archive the packetized data, and here it says on page 19 in the AO, where the level zero products would be archived by the Project. Could you clarify that?

DR. GARVIN: Okay. The question is, is there a discrepancy in what has been discussed about Project data archival between the AO and the presentation given earlier, and Rich, do you have answer?

DR. ZUREK: Part of the problem is what is level zero. There are different definitions of that. When we wrote that requirement for the AO, we were using a broader one, which level zero is just the raw data itself. In the data management plan, which has been working its way through the signature cycle here, there's a more specific distinction between level zero data and what we would now call and what Jim showed you is the raw packet data. And whether it's packetized or not, we're going to look at that during the phase to see.

The idea is that the Project will preserve a record of what comes down from the spacecraft, and the issue is, is there any other process in that, including the depacketization?

QUESTION: I guess the point of clarification is do the individual instruments need to be responsible for looking at the packetized data, looking for duplicates, looking for retransmission, all of that type of stuff, in terms of getting all the data down?

DR. ZUREK: Filling drop outs, duplicate packets. That, the Project will take responsibility for because it's the interaction with the DSN. So that will begin by the Project, and the teams will not have that. That will be done before the Project delivers that set of data to the investigators' data processing.

DR. GARVIN: Okay. Thanks, Rich. Okay. We have a question. If you could stand up and articulate it, please.

QUESTION: Can you shift E/PO dollars from early Phases to Phase E?

DR. GARVIN: Okay. The question is there's a guideline on the Education Public Outreach dollars, can they be shifted across the boundaries separated by the PDR, essentially?

QUESTION: We had a history where, basically, money in each phase is a different color, and you can't mix them?

DR. GARVIN: I think we will have to caucus on this one to see. Let me make this comment. It has been, in the past, the case that one could move the money, and we have a new program plan here, move the funding allocation, I should say. We have a new guideline here with the umbrella

Mars Exploration Program, E/PO, as well as that, which is responsible to be responsible by the PI and his or her team. So I think we'll have to look at that. I don't have an instant answer, so we'll take that one under --

QUESTION: Well, I don't need an answer right now.

DR. GARVIN: Okay.

QUESTION: It implies when you read in there that they understand, the E/PO, most of the cost will come when you get the data, which is way after when you have all your money.

DR. GARVIN: I think the one issue that is, essentially, the point is by Jeff Rosendahl, developing the education plan that will be then used once one has the data, and there is the question of how that is based.

QUESTION: Well, a guideline of one- to two-percent.

DR. GARVIN: Right.

QUESTION: You don't have much money at that time.

DR. GARVIN: Exactly.

QUESTION: Okay. Change the subject.

DR. GARVIN: Okay. Next question. Rich.

DR. ZUREK: Probably, as a quick estimate, it's probably about a third of the time. That's from the time when it like starts in darkness, through darkness, and comes back out. It's roughly the same, I mean, an eclipse for this orbital period comparable over periods about a third of the time. So we will double-check that, and then come back with an answer to the web site, as well.

QUESTION: Okay. The context camera that you guys are supplying. Can we put a minus blue filter on it?

DR. GARVIN: The question, let me just repeat it for everyone so we get this down. The question is, can the context imager include a blue filter, this reminds us of what's going on with MGS MOC now. And do we have a response, Rich?

DR. ZUREK: We have an opinion, let's put it that way. The context imager right now is monochrome, that is one color. Once we see the proposals, and you should specify in your proposal. There is, in the AO, a description of what this is. It's one color, it's special resolutions --

QUESTION: It says panchromatic.

DR. ZUREK: Panchromatic.

QUESTION: But it says no filter.

DR. ZUREK: But it says no filter. And so there's no specific color capability that's advertised there, and you shouldn't assume that it has one. If your investigation requires that, then you should specify that in there, and it's our intent to take a look at what is required for a facility instrument to support this. That's got to be done within all the other constraints, mass, budget, etcetera. But we're going to wait before finalizing the specs on this until that point because it is a facility instrument. Don't just throw it over --

QUESTION: To see the stuff on the surface, you want to get rid of the atmosphere, so you want to cut it out, and that would make it more useful.

DR. ZUREK: I understand. You're not arguing necessarily for color but for a specific band pass to enhance the --

QUESTION: Yeah, we need more information. Can I trigger it automatically?

DR. ZUREK: Can you trigger the context imager automatically? The context imager would be part of the targeting discussion about which instruments are observing during the given targeting opportunity. It will be there to support, if requested by either the camera or the imaging spectrometer. The context imager will be provided. That's why it's there.

QUESTION: But you're going to provide it via ground planning and not allow me to have an electrical interface, so if I anticipate to take a quick picture --

DR. ZUREK: Yes, it's assumed that the context imager is controlled outside any of the other instruments.

QUESTION: And it will be archived with the data, too?

DR. GARVIN: It will be archived by the Project for the general use of the public.

DR. ZUREK: It is the intent to provide the context imaging data to the investigations as part of their data analysis.

QUESTION: So it will have a very similar number? So it's always associated with it?

DR. ZUREK: Well, it can be run independently if the Project Science Group determines that that's a useful scientific thing to do. But its purpose for being there, as a facility instrument, is to support the other two investigations. It will have the same level of information as we would provide for any investigation, and the intent is to provide that data to the others for their analysis and investigation, including planning for subsequent observations.

DR. GARVIN: Other questions? Yes, please sign in and identify yourself.

QUESTION: The question has to do with the subsurface radar. If I make the assumption that it will be supplied, and I want to bid, and I think you call it the deputy team leader, and I shall also have some responsibility to help in the development of that. The question is can, as part of my responsibility, bid to provide some of the hardware that goes with that to funding from this AO, and if you're answer is yes, is there a limit to how much funding I can ask for?

DR. GARVIN: Okay. The question is as a proposing individual to be the deputy team leader for the shallow subsurface sounding radar that will be provided by our Italian partners, can the person in that capacity, upon selection, through their investigation, if you will, provide hardware that will support the operations of that radar in some way, right, development, I'm sorry, building of the hardware.

And we have a position, I'd like the Project to make a comment, but I'll point out two things. Number one, any additional scope of any investigation, beyond that which is outlined in the AO with the budgeting numbers that are in there, comes in competition with the funding for the group one science instruments, which, of course, do not include the radar. So understand the first rule of thumb is that group one takes precedence over all other investigations for time allocation of the spacecraft, data volume and allocation, etcetera, etcetera, etcetera. So given that, you know, I'd like, Rich, I think we had a response, I'll let you articulate. That's the guiding response.

DR. ZUREK: What’s the important part is that, in a way, you're asking for a group two investigation by providing, even in the development part of it, beyond just participation of the person as an investigator on the science team. And as Jim said, that's going to be in competition with the other things, and group one still has the higher priority.

Now there's also another issue, which is we're providing team members for an investigation that has its own ideas and may have investigators listed through their process to provide similar things. We haven't worked out the details of that cooperation, but right now, we're assuming that there is a radar that is supplied in an investigation that is capable of analyzing the data and returning it back to the system without further exchange of funds between NASA and the Italian Space Agency, other than what's listed for the team members in the proposal.

MR. GRAF: One or two other items. To answer your question directly, we're not precluding you from proposing that in the AO, but I think what my colleagues have tried to describe is that there is a priority, as laid out here, and so as the resources are used up, there will be less and less available for group two and other types of instruments.

The other thing that I can say is that there is nothing in our mind, and I got to look for Steve Ballard here, nothing in our mind that would preclude you from approaching the Italians, if you have a piece of hardware that you would like to propose to them for their incorporation. Even if we accepted you, let's say, okay, we'll take this piece of hardware, we could only do it provisionally because we cannot push our designs upon our Italian colleagues. But again, nothing would preclude you from going and trying to deal with them, as long as you did it within the ITAR restrictions that Steve Ballard and company laid out.

DR. GARVIN: Was that adequate?

QUESTION: Yes. Is that instrument a copy of something that's already been built and flown or is it a new development?

DR. GARVIN: No. Totally new development. And I should add that the aims of that instrument are, Rich described very well, and I think it's important to comment again. The instrument has the ultimate goal of providing subsurface context information that will aide in interpreting some of the actual group one objectives, which are to look at structures of layers that contribute to the surface layer on Mars in a place that we haven't ever looked before at kilometer scales, very many different horizontal and vertical scales, fundamentally different ones, I should say to be fair, and those that will be investigated with MARSIS on the Mars Express, so it's a new development, a new class of system to be flown in space, and I think that's important to understand.

And that's why, in particular, the facility science team selected from this AO for that is vital to being part of the whole process, and we do anticipate, subject to availability of funds in the process of our Mars Exploration Program, having a participating scientist program for the mission near time of launch to contribute to purely data interpretation functions resulting from processed data from the instrument, not resulting from the development and other things that would be a facility science team member.

Okay. Other comments, questions?

QUESTION: I have two related ones. The AO gives budgeting guidelines for launch plus 30 days. Are there any guidelines for phase E?

DR. GARVIN: Good question.

QUESTION: And then the web-based title page calls for a statement for total cost to NASA.

Does this mean launch plus 30 or through phase E?

DR. GARVIN: Good points. Do we need to caucus on that one? I need to check the --

MR. GRAF: On the second one, we'll have to get back and check.

DR. GARVIN: Right. Okay. So the answer is, there is no guideline for phase E, as Jim just said, and the other, we will take under caucusing and provide you with an answer here or in writing thereafter. Good question. Yep?

QUESTION: In order to get a cover page, you've got to go to a web page. In the web page, they have a slot there that says total cost in NASA OSS or whatever.

DR. GARVIN: Right.

QUESTION: And does this mean through --

DR. GARVIN: Through phase E or through phase, right.

QUESTION: Does that include phase E? That was the question.

DR. GARVIN: The intent, of course, I

think it is, in my understanding, yeah?

MR. GRAF: Let's not speculate.

DR. GARVIN: Right. Okay. Other questions? Yes?

QUESTION: We're doing new technology developing, imaging spectrometer imaging development on imaging spectrometers with planetary instrument definition and development funding, as well as some other funds. So I'm interested in knowing if you plan to have a list on your web page of organizations that are interested in teaming. I know some other NASA proposals have provided that on the AO web pages to allow people to list their organizations, if they're interested in teaming.

DR. GARVIN: Okay. The question is, and it's a good one, is whether there are, there will be sources of information available right now with the AO on the street, so partnering and teaming that would be accessible through the various web sites that we have. Let me remind you, these are, in fact, the library one and the one at Langley, as well.

Right now, of course, we don't have such information. I'm not sure if we have any plans to develop it. Right as of now, I don't know that we have any plans. This has been done, I know, in some cases for ESSP and other types of investigations within the context of NASA, but I don't, Jim, comment?

MR. GRAF: Right now, I don't think we can answer that question.

DR. GARVIN: Okay.

QUESTION: Just to add one thing as an example. The Earth System Science Pathfinder, the AO for that solicitation has a page, along with appropriate disclaimers that NASA is not endorsing these organizations.

DR. GARVIN: Understand. It raises an important issue about providing connection information. That's always been an intent. We need to take under advisement how one could facilitate that for this more narrowly focused solicitation, which may end up causing an effect.

Okay. Thank you. Good question.

Additional questions or points of clarification? Yes?

QUESTION: If we don't have a spacecraft contractor selected, then the Langley people and that part of the selection process, they're going to be doing it from the PIP, not to any other capability of the contractor brought on board during the selection process.

DR. GARVIN: Okay. So the question, which is a very good one, is given the timing of selection of the RFP, how will the TMCO process evaluate the technical accommodatability of the instruments that will arrive simultaneously for review and evaluation beyond the scope of anything that was specified in the RFP and is listed in the PIP. We'll caucus for a minute on the state of how we respond to that.

We have a couple of points. First, of course, the legal requirement is that, in fact, the TMCO will address the accommodatability in their evaluation against the PIP, which essentially is the specifications of the RFP. If you remember, and I can find it in my pile of stuff, the flow chart, which is in your package, there is a final accommodation review after the gateway of categorization in the parallel flow of control. At that point, we will have had selection of the spacecraft formally, selection through the Source Evaluation Board, Technical Evaluation Board, in which case the Project can make the assessment, beyond the timing of the TMCO, as to whether there are issues.

But I think there's another point that's very important, so there will be a second pass, if you will, in this, Ed. The other issue is, of course, proposers must develop their proposals along the guidelines of the PIP, not assuming any other capabilities. If they choose to do something else, they have to document those and their points of departure from what we've stated and, you know, can be used however by the evaluation process. So the PIP still rules, I guess is the short answer, but there is a final --

QUESTION: I am worried about the reverse.

DR. GARVIN: Okay. The issue raising is

that one writes one's proposal against the PIP specifications, the spacecraft comes in, it doesn't meet those quite in the sense that the proposals were written, and how does one adjudicate that challenge, if I understand you correctly.

And I think there's a couple of processes. One is, of course, we will have a contact negotiation for the winners to evaluate how to best develop the interface and the responsitivity to accommodating what we actually will fly. That's one process. Jim, I guess I could ask you if there's any other follow-up you would like to add.

MR. GRAF: As Jim said, first thing, the first pass through will be by the TMCO, and it will be judging you against the PIP requirements.

The accommodations would be, suppose you met those, but you were asked for the highest level launch vehicle because you needed all this volume. You know, maybe it wasn't specified adequately in the PIP, and you come in and say hey, I want to fly something that's a couple of meters across in diameter, an imager, and it's going to be six or seven meters long, and we don't do an accommodation study. We say hey, let's drive the overall cost of the overall program. So maybe, in fact, we didn't specify it deliberately, but common sense would tell you that you shouldn't do that, and we would have to come back to NASA Headquarters and define to them what the impact of selecting this would be, and they would have to take that under advisement.

But if you were conforming to the PIP and were reasonable in the accommodation requirements, I see no reason that there would be any second opportunity to ever throw a good investigation, a category one, out.

DR. GARVIN: Other questions? Yes?

QUESTION: I had a question about targeting for the two PI-led instruments. Well, you know, the AO suggested there will be two independent PI-led investigations, but [the] AO also suggested there will be highly coordinated targeting, even Project-led somehow. I wonder if you could expand on how that might work on a daily basis? Say the question is just do you ever anticipate a time when

PI's would actually lead their own independent investigation looking at their own independent sites?

DR. GARVIN: First, let me comment. I'd like then to turn to Rich as our Project Scientist, who's thought a lot about the challenges of targeting in a mission, which is, perhaps, more akin to a Hubble Space Telescope operation than an MGS. I think there is a philosophy difference.

I'll answer your second question and let Rich expand upon the answer to the first. Firstly, these are PI-led investigations. The PI's will always have a large fraction, if not a majority, of the control of targeting against the constraints of the mission, safety constraints, of the overall asset. So if that was not clear, given your second question, I hope that is, indeed, clear.

But I think one must recognize the standpoint that we have now having a Mars Exploration Program with a capital P. This mission is not the end. It's one piece of a large chain of assets around Mars, and the program here at

Headquarters at JPL implementing this for everyone, would like to control some of the targeting in the better interest of, for example, as I presented earlier, identifying and certifying landing sites for missions that will have a much broader scope than even this mission in the future.

We have a development process in place that Rich has been leading. I'd like him to comment on how we will actually work, at least as of today, the targeting of these high-resolution assets.

Rich.

DR. ZUREK: Yes, this is going to be a different operation than for Mars Global Surveyor for the simple reason that what we could return with either instrument, the high-resolution imaging spectrometer or camera, to fill up the data streams that we have. Our going-in position is, during the primary science period, that we're not going to have an allocation, just tell each of the groups okay, fill it up with what you want. Besides, we think that much of the science to be gained from this mission is from the synergism of the various instruments.

So our going in [stance] is that we're going to have, something we're going to call a targeting acquisition group, and that group is going to be part of the PSG, so it will have representation from all the teams involved. We're going to bang it out, and we're going to work out what the plan will be.

And we will have a plan, and our idea is this is not describing the AO, but our present thinking right now is that we will come with a list of targets that we would continually review and update, and we'd have sort of a long horizon so that we don't miss an opportunity to capture a very high-priority target, so we'd have a long horizon, but as it got closer, we'd work out the details, okay, are we going to have both the imaging spectrometer and the camera look at the same place.

An important point to remember is the data rate is not constant throughout the mission. There is going to be an opportunity in the second Earth year of the primary science mission when the data rates are going to be high because Earth is close to Mars, and we'll be able to get a lot more data back. And our idea is that during those periods, there will be a lot more opportunity, probably, for the individual teams to pick their targets.

And no, we're not going to require that every time one takes something, the other one has to take that target, too. On the other hand, we don't want to waste our opportunities of how many places we can target. We're going to work it out. There's not going to be a defined allocation that cleanly separates it so that each instrument can then operate for a Mars year independently of the rest of the payload. It's going to be more interactive than that.

DR. GARVIN: And I'd like to add one other development that we're imagining and trying to make possible that expands upon what Rich said, which is given the sense of the assets that these high-resolution sensors will have, a process in which guest observers for simple targets will be permissible, much like the telescope allocation team allows for Hubble targets of opportunity that would need planning in advance. These could be student targets. They could be outreach targets. There's a variety of different niches they would fit.

That would be a large fraction of the PI's allocation, his or hers, but they would be something we will reserve the right to allocate. We think that's going to be vital as part of the program-wide E/PO function.

One other thing. I think by the time we are into this mission, the idea of there being a program-wide landing site science engineering evaluation team selected, in fact, peer competed, that would advise the Project for some of these allocations in that role in a way that Rich said is something that we're sort of formulating now so that the sense of looking forward to Mars sample returns and other types of things would be built into the process of this mission looking six years ahead or more at places we might want to go.

So anyway, I hope that answered your question. Good questions. Other comments?

(No response.)

Again, all the written questions that were submitted have been posted on the web site, the one shown earlier, and we'll post the ones here in our responses, as well, and the ones that came in after the 11th, I should add as well.

Other comments? Any other comments the Project chooses to make? Rich has a couple of follow-ups on the basis of points raised that he'd like to, here Rich.

DR. ZUREK: Thanks. One of them was about the 70 meters, and the answer definitely was that we're not guaranteed to have the 70 meters during that period, all three of the stations, and we wanted to make sure that the spacecraft had the capability to do 16 hours of downlink, two-thirds of each day down to the 34-meter net, which has multiple stations and are more reliable in the sense of being there for that kind of coverage. That capability is there. We'll continue to look at that, particularly for key periods like the early part of the science mission, when Earth and Mars are far apart and data is relatively low down to the 34 meter.

The other issue about the elliptical orbit. The SDT asked the project to look at a number of alternative orbits, including low-altitude circular orbits, and it wasn't clear that those would be stable, that is, that we wouldn't end up using a lot of fuel to maintain station keeping during those low-altitude orbits. So this 200 by 400 was the best compromise. You'll notice that, as it's presently mapped, it doesn't give you even coverage over the planet. You tend to be a little higher over the northern hemisphere than you do over the southern hemisphere. We will continue to look at that as we get a better definition of what the spacecraft's capabilities are and to refine the orbit altitudes in such that we feel that we can be at. And finally, there's that question of planetary quarantine that we have to deal with, ultimately, as well.

We'll continue to look at those aspects, but right now, you should plan using the 200 by 400 kilometer orbit. I do want to emphasize we're looking for the capability of instruments to operate from any of those altitudes, just in case we get to Mars, and we find, you know, the gravity field is a lot more lumpy down here than we knew because we haven't flown at those altitudes before, and we need to make sure and preserve that capability of having the payload operate at that range of altitudes.

DR. GARVIN: Okay. If there's no further questions, I would like to thank you all for coming on behalf of Headquarters, myself, Dave Senske, Orlando, Ramon, and our team at JPL, Bill, Rich, Jim, Dan, and Howard. You know where to find us. You see the web sites. We will post things. August 22nd is the due day for proposals, and we really look forward to seeing your inputs to us. This is a real exciting mission, and a lot of us are really looking forward to it actually flying and delivering the science. So thank you all for coming. We're done.

(Whereupon, the above-entitled matter was concluded at 1:52 p.m.)